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Summary of stock assessment information for selected early returning chinook salmon populations of the Fraser River watershed

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ABSTRACT

Escapement histories and recent catch data were summarised and reviewed for four early-timed Fraser River spring-run chinook populations: Birkenhead River; Coldwater River; Spius Creek; and upper Chilcotin River. A thorough assessment of the status of these populations is difficult since the quality of spawner escapement data is generally poor for Coldwater River, Spius Creek, and upper Chilcotin River populations although there was a short but consistent time series of surveys on the Birkenhead River. Analyses of the data do not indicate any temporal pattern although escapements of each population have been extremely low (<250 spawners) on several occasions over the past decade. Based on DNA and CWT analyses, it is clear that most harvest occurs in the lower Fraser First Nations fishery, especially for Spius and Coldwater River populations, although Birkenhead and Chilcotin populations are caught on occasion in marine fisheries. The apparent exploitation rate for the four populations (pooled) was about 33% by the end of April, 2000.

RÉSUMÉ

Ce document résume et examine l'historique de l'échappée et les données de capture récentes pour quatre populations de chinook à remonte printanière hâtive, soit celles de la rivière Birkenhead, de la rivière Coldwater, du ruisseau Spius et de la rivière Chilcotin supérieure. Il est difficile d'évaluer de façon approfondie l'état de ces populations, car les données d'échappée de géniteurs sont généralement de mauvaise qualité pour les populations de la rivière Coldwater, du ruisseau Spius et de la haute Chilcotin, bien que l'on dispose d'une courte série chronologique cohérente pour le stock de la rivière Birkenhead. L'analyse des données n'a pas permis de dégager de tendances temporelles, mais chaque population a présenté des échappées extrêmement faibles (<250 géniteurs) à plusieurs reprises depuis une décennie. Selon des analyses d'ADN et des analyses fondées sur l'utilisation de micromarques codées, il est évident que la plupart des captures sont attribuables à la pêche autochtone dans le bas Fraser, en particulier pour ce qui est des populations du ruisseau Spius et de la rivière Coldwater; des saumons appartenant aux populations de la Birkenhead et de la Chilcotin sont parfois pêchés en mer. À la fin d'avril 2000, le taux d'exploitation apparent des quatre populations (groupées) se chiffrait à environ 33 %.

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1 Introduction

The Fraser River is the largest chinook salmon producer in Canada (DFO 1999). Fraser River chinook salmon are major contributors to commercial, recreational and First Nations fisheries, both within the Fraser and on the Pacific coast between Washington and Alaska.

For management purposes, chinook populations returning to the Fraser are grouped into three timing components: spring-run populations peak in migration past Albion in the lower river (50 km upstream of the mouth) prior to July 15; summer-run populations peak in migration between July 16 and August 31; and fall-run populations peak in migration after September 1. Co-incident with the timing, the spring-run is dominated by red-fleshed fish, whereas the fall-run are almost entirely white-fleshed, however some white-fleshed fish exist among spring- and summer-run populations.

Spring-run populations declined in abundance prior to 1980, and measures were implemented to rebuild chinook populations coast-wide (DFO 1995). In 1980, DFO closed the gillnet fishery that targeted chinook in the lower Fraser River, delayed the troll fishery openings in the Strait of Georgia until July 1, raised minimum size limits in ocean recreational fisheries from 45 cm to 62 cm, and closed in-river recreational fisheries. The Pacific Salmon Treaty, signed in 1985, also reduced harvests, with ceilings imposed on interception fisheries targeting chinook.

Following these measures, escapements to an aggregate of 25 spring-run populations began to respond favourably, increasing from approximately 22,000 in 1980 to a high of 59,800 in 1994 (Figure 1.1). With the increased escapement came an expansion in freshwater recreational and First Nations fisheries, particularly in the lower Fraser River. Since 1998, there has been very little fishing targeting chinook in Canadian marine waters, other than the recreational fishery.

The spring-run escapements began to decline after the high escapement in 1994 and concerns were raised by the public and DFO staff residing in the BC interior. Preliminary analyses indicated many of these spring-run chinook may be harvested in the lower Fraser First Nations fishery. Subsequent discussions indicated a more detailed summary of stock assessment information was required. It was decided to focus initially on four of the earliest populations; Birkenhead River, upper Chilcotin River, Coldwater River and Spius Creek.

The primary objectives of this paper are to: (1) summarize stock assessment information for the four early-timed chinook populations; and (2) describe the frequency of occurrence of these populations in freshwater and marine fisheries.

2 Methods

2.1 Study Area and Life History Descriptions

2.1.1 Fraser River Spring-Run Aggregate

The Fraser River watershed is the largest in British Columbia (~230,00 km^2) and supports one of the largest groups of chinook salmon in North America (Fraser et al. 1982). The spring-run aggregate includes about 25 populations that spawn throughout the watershed, yet most spawn in the upper watershed (Figure 2.1). Most populations spawn from early August to mid September, have mainly a stream-type life history, and sexually mature at ages 4 to 6 (DFO 1995). Historically, most marine catch occurred in southern BC (inside/outside), with some occurring in north and central BC and Alaska. The spring-run appears to return to the Fraser following the southern route through Juan de Fuca. The early-timed populations in the spring-run aggregate begin arriving in the lower Fraser River in March (or earlier), and typically, are almost entirely through the lower river by mid-June.

2.1.2 Birkenhead River

The Birkenhead River flows approximately 60 km south-easterly from the Chipmunk Mountain range into Lillooet Lake (Figure 2.1). The system supports the five species of Pacific salmon, as well as rainbow trout, steelhead, Dolly Varden and bull trout. The chinook population spawns mostly in the upper reaches of the Birkenhead River that are accessible to anadromous fish. Spawning peaks during the second week of September, however the fish arrive in the terminal area as early as April (Fraser et al. 1982). Birkenhead chinook are mainly stream-type freshwater life history. At maturity, they return to freshwater mainly as total age 5 and have large body size.

Birkenhead chinook are one of the most genetically distinctive Fraser chinook populations and have one of the lowest levels of polymorphism and heterozygosity. This likely reflects their small population size, at least in recent history, and low levels of gene flow due to its spatial and temporal isolation from other populations (Beacham et al. unpublished.).

2.1.3 Coldwater River

The Coldwater River flows northeast approximately 90 kilometres from its headwaters in the Cascade Mountains to join the Nicola River at Merritt (Figure 2.1). The river is characterised by a moderate gradient, with a broad floodplain, and is subject to rapid fluctuations in flow due to fall and winter 'rain-on-snow' events. Agricultural activity is extensive in the lower reaches and logging has occurred throughout the watershed. Construction of the Coquihalla Highway in the mid-1980's resulted in numerous diversions and extensive bank stabilisation work. Chinook and coho salmon spawn and rear in the system, in addition to rainbow trout, steelhead, bull trout and Dolly Varden.

There are two spatially and temporally separated chinook populations in the Coldwater River, termed early and late components, and both are part of the Fraser River spring-run aggregate. This study focuses on the early component, which enters the Coldwater as early as May and completes spawning by the end of August in areas upstream of the Coldwater Indian Reserve

No. 1 bridge. The late component enters the Nicola drainage starting in mid-July and is part of the later spawning Nicola River mainstem population. The late component spawns in the lower reaches of the Coldwater River as well as the Nicola River throughout September. Coldwater chinook freshwater life history is dominated by the stream-type strategy. At maturity, they return to freshwater mainly as total age 4 and exhibit a small body size. From herein, Coldwater River chinook refers to the early component.

2.1.4 Spius Creek

Spius Creek originates on the northeastern slopes of the Cascade Mountains and flows north approximately 50 km to join the Nicola River west of Merritt (Figure 2.1). A moderate to steep gradient characterises the upper reaches of Spius Creek and most of the stream is confined within a narrow, steep-sided valley. Agricultural activities occur in the lower reaches, and much of the upper watershed has been logged. Similar to Coldwater River, Spius Creek is subject to considerable flow variations, especially during "rain on snow" events. Chinook, coho, steelhead and resident rainbow trout and Dolly Varden inhabit the system.

Similar to the Coldwater River, two spatially and temporally separated chinook populations (termed early and late components) exist in Spius Creek and both are part of the Fraser River spring-run aggregate. The early component spawns in late August mainly in Maka Creek, a tributary that arises to the south of the headwaters of Spius Creek, and enters Spius Creek approximately 35 km upstream of the confluence with the Nicola River. The late component spawns in the lower reaches of Spius Creek and the Nicola River mainstem throughout September. Spius chinook are dominated by stream-type freshwater life history. At maturity, they return to freshwater mainly as total age 4 and exhibit a small body size. From herein, Spius Creek chinook refers to the early component.

2.1.5 Upper Chilcotin River

The upper Chilcotin River drains southeast from the Itcha Range approximately 100 km into Chilcotin Lake (Figure 2.1). Chinook and coho spawn and rear in the river, and bull trout and Dolly Varden are resident. Ranches and farms are located on the floodplain above Chilcotin Lake. Upstream (northwest), the stream's gradient increases and its' course narrows.

Similar to Spius Creek and Coldwater River, two spatially and temporally separate populations spawn in the (little) Chilcotin River and are referred to as upper and lower Chilcotin chinook. The upper Chilcotin River population arrives in Chilcotin Lake by mid-June, and remains there until late July, when they move upstream to the spawning grounds. Spawning peaks before August 15 most years, although some late spawners have been observed into September. Lower Chilcotin River chinook enter the river in late July and spawn in September in areas between the Chilko River confluence and Chilcotin Lake. No information was available about the freshwater life history, ages at maturity or body size of upper Chilcotin chinook.

2.2 Data Sources

We assembled stock assessment information mainly from test fisheries, commercial, First Nation and recreational fisheries, and escapement monitoring time series. Another potential source of information is traditional ecological knowledge, but we were unable to collect and summarize this for the four selected populations. While the time series is short, the escapement summaries provide indexes of spawning abundance for each population. Some fisheries harvest chinook from mixed-populations and the abundance of specific populations among the catches are assessed with several methods.

It was not possible to identify individual populations among catches from historic commercial, First Nations, and test fisheries, until the use of coded-wire-tags (CWTs) became common in the early 1980s. CWTs were applied to juvenile chinook, either fry or smolts, with codes unique to specific release groups in each river and year, and their adipose fins were removed to identify them. CWTs enabled the estimation of population specific catches for sampled fisheries and provided information about their spatial and temporal distribution and confirmed ages at maturity. In the late 1990s, tissue sampling and DNA identification were used to identify the population composition among catches from mixed-population fisheries, thus populations with little or no CWT marking could be identified.

2.2.1 Escapement Summaries

Escapement history information was summarised from the DFO SEDS (Salmon Escapement Data System) database, DFO Stock Assessment summary estimates, First Nations technical staff and Fishery Officer field notes, BC-16 summaries and hatchery information. Where conflicting information exists, we attempted to resolve the information into a consistent and useable time series for each river system. Because escapement records for three of the systems require separation into early and late runs, some years' data are not useful, and are identified accordingly.

The following criteria were used to determine the utility and reliability of escapement:

1) Were surveys carried out at an appropriate time and place to estimate escapements to the early-timed population, without observing fish of the late component? This question is particularly important for Spius and Coldwater populations due to the potential spatial and temporal overlap with the late component when survey dates and locations were not recorded.
2) Were surveys carried out in a "spot check" or more thorough manner? Often, surveys of escapement were indicators of the presence of spawners only, and not useful to estimate escapement. For example, some information on escapements were recorded anecdotally while collecting broodstock on Spius Creek and Coldwater River.

A detailed description of the methods used and results obtained from escapement surveys of the Birkenhead, upper Chilcotin, Spius and Coldwater rivers in provided in Appendix 3.

2.2.2 Population Identification in Catches from Mixed-Populations

2.2.2.1 CWT Recoveries

The Mark Recovery Program (MRP) database was searched for tagging and recovery information for the selected populations from 1985 to present. There has been no CWT marking of the upper Chilcotin population, although some CWT marking occurred for the lower Chilcotin River population between 1988 and 1991. CWT recoveries were sampled in marine fisheries as described by Johnson (1988). Recoveries in freshwater recreational fisheries were derived from voluntary head recoveries, and estimates of CWT catches assembled from creel surveys undertaken by departmental staff and local stakeholder groups (e.g. Bratty et al. 1998; Palermo and Thompson 1999a, b; Schubert 1995).

The coast-wide CWT and First Nations fishery recovery databases were examined for all recoveries of releases from Spius Creek, Coldwater River and Birkenhead River stocks from 1985 to present (Appendix 1A). From 1985 to 1998, about 1,405,048 CWT juvenile hatchery chinook were released from Birkenhead (also named Pemberton Fish and Game) and Spius Creek hatcheries. Most of the releases from the Birkenhead River population were as fed fry, however all releases since 1991 (Spius and Coldwater) and 1993 (Birkenhead) were yearling smolts. Birkenhead River releases (726,160) exceed those from Spius Creek(143,625) and Coldwater River (535,263).

Very few CWT recoveries exist for the selected populations, and from 1986 to 2000, only 82 CWTs were observed in marine fisheries, 76 in freshwater fisheries, and 280 in escapement samples (Appendix 1A). None of these populations have been formally sampled on an annual basis for recovery of CWTs from escapement. Of the 74 ocean recoveries, the majority (69) were of Birkenhead origin and most were from Alaskan troll fisheries, with one recovery in the Alaska recreational fishery. In contrast, no Spius Creek or Coldwater River CWTs were recovered in Alaska. No recreational or commercial fishery recoveries of Spius Creek, Birkenhead River or Coldwater River CWTs have occurred in Canadian tidal waters since 1995.

Recovery sampling of Fraser First Nations fisheries has not been undertaken in a manner suitable for inclusion in the MRP database, however a separate file of recoveries was provided by T. Robertson, Fisheries Management Lower Fraser Area, for select sampling, and voluntary recoveries from 1995 to 1999. No catch-sample ratio information was available for most recoveries.

2.2.2.2 DNA Stock Composition Analysis

Tissue samples taken from chinook in the West Coast of Vancouver Island (WCVI) troll (1998-2000), Victoria and Georgia Strait recreational (1999-2000), and the lower Fraser First Nations (1997-1999) fisheries were sent to the Molecular Genetics Lab at the Pacific Biological Station (PBS) for analysis. These fisheries were selected as the ones most likely to harvest early returning Fraser River chinook. For mixed stock analysis 6 microsatellite loci (*Ots100, Ots101, Ots102, Ots104, Ots107* and *Ssa197*) were analyzed for the 1998 WCVI troll and 1997-1998 lower Fraser First Nations fishery samples. An additional 7 microsatellite loci (*Ogo2, Ogo4, Oke4, Oki100, Omy325, Ots2* and *Ots9*) were analyzed for the 1999-2000 WCVI troll, 1999-2000 Victoria and Strait of Georgia recreational, and 1999 lower Fraser First Nations fishery

samples. For details on sample preparation and DNA extraction, and microsatellite analysis see Nelson et al. (1998, 2001). Beacham and Wood (1999) provided a more complete description of the methods used to identify alleles using this technology. Microsatellite loci were sized on an ABI Prism 377 sequencer (B.E. Biosystems).

The southern chinook salmon baseline currently consists of approximately 16,000 fish from 108 populations ranging from the central coast of British Columbia to Oregon (Appendix 2). The Fraser baseline, a subset of the southern baseline, consists of 48 populations and approximately 7,700 fish. For the Fraser River fisheries there appears to be reasonably good coverage of the contributing populations in the Fraser baseline so estimates are provided on a populations-by-population basis instead of regional groupings. However, for some populations, group estimates of stock composition are reported because of our present inability to distinguish between these populations. For example, in the Nicola drainage annual differences within the Nicola and Coldwater populations were about three times larger than differences between these two populations (Beacham et al., unpublished data).

Reported stock compositions for fishery samples are the point estimate of each mixture analyzed, with variance estimates derived from 100 bootstrap simulations. Each baseline population and fishery sample was sampled with replacement in order to simulate random variation involved in the collection of the baseline and fishery samples. Genotypic frequencies were determined at each locus in each population and the statistical package for the analysis of mixtures software program (SPAM) (Debevec et al. 2000) was used to determine stock composition of the mixtures. SPAM uses expectation-maximization, and convergent-gradient algorithms for maximum likelihood estimation procedures (Pella et al. 1996).

2.2.2.3 Population-Specific Harvests from Mixed-Population Fisheries

Other than CWT recovery information from marine and recreational fisheries, there was little information available from formal sampling programs on mixed-population fisheries until the initiation of DNA stock identification programs. In-river and terminal fishery catches were estimated from creel survey results where significant fisheries intercepted the stocks in question, or from local fishery officer estimates.

Population-specific harvests were estimated from DNA stock compositions and independent catch estimates. The harvest of population *i* in time strata *j* ($\hat{H}_{ij}$) was estimated from the estimated catch of all stocks combined ($\hat{C}_j$) and the proportion of the population in the fishery sample ($\hat{P}_{ij}$; equation 1).

(1) $$\hat{H}_{ij} = \hat{C}_j \bullet \hat{P}_{ij}$$

The harvest variance ($v(\hat{H}_{ij})$) was estimated from the variance of the proportion of the population in the fishery sample ($v(\hat{P}_{ij})$) and the catch estimate (equation 2).

(2) $$v(\hat{H}_{ij}) = \hat{C}_j^2 \bullet v(\hat{P}_{ij})$$

Variance estimates were not available for catch estimates from the lower Fraser River First Nations or WCVI troll fisheries, therefore calculated estimates of precision associated with

harvests underestimate the true precision. Variance estimates for catches in the Victoria and Strait of Georgia recreational fishery were excluded for consistency with the other fisheries.

2.2.2.3 Apparent Exploitation Rates

We did not attempt to determine survival or exploitation rates from CWT recoveries due to few recoveries in most freshwater and marine fisheries, the lack of valid expansion factors associated with many of the freshwater recoveries (recreational and escapement) and many of the marine recoveries being select recoveries, and potentially significant amounts of catch occurring in un-sampled fisheries.

Apparent exploitation rates for 2000 were estimated by pooling the four populations (rather than the individual populations) because of limitations with some of the stock assessment information. The total harvest was estimated from the sum of the harvests in the WCVI troll, Victoria and Strait of Georgia recreational, Albion test, and lower Fraser First Nations fisheries. Harvests in the WCVI troll and Victoria and Strait of Georgia recreational fisheries were estimated from DNA analyses and catch estimates. DNA analyses have not yet been conducted for the Albion test fishery and lower Fraser First Nations fishery samples collected in 2000, yet catch estimates were available. We estimated monthly stock composition estimates for 2000 from the averages of the 1997-1999 estimates for weekly periods. We included harvests from October, 1999 through to the end of April 2000.

We did not include the harvests from May and June in the calculation because the stock composition estimates for May and June were suspected to include many fish from the lower Chilcotin and Nicola River mainstem populations, thus confounding any estimates of the earlier populations from those drainages.

Monthly harvest estimates for the four populations (pooled) were summarized for the WCVI troll, Victoria and Strait of Georgia recreational, Albion test, lower Fraser First Nations, and lower Fraser recreational fisheries to indicate the relative influence of each. We summarized harvest estimates from the fall of 1999 to June 2000. For the Albion test, lower Fraser First Nations, and lower Fraser recreational fisheries we estimated stock compositions from the averages of the 1997-1999 estimates for weekly periods. Stock composition for the March 2000 lower Fraser First Nations fishery was estimated from the 1997-1999 average April stock composition estimate from the lower Fraser First Nations fishery.

2.2.3 Mixed-Population Fisheries

Stock assessment information was summarized for fisheries sampled for DNA analysis and CWTs, and those with catch estimates. There are other fisheries that we have been unable to obtain data from that we did not attempt to summarize. Examples of these fisheries are the First Nations fisheries in the Fraser River watershed upstream of Sawmill Creek; in Birkenhead River, and Lillooet Lake and River; in the marine portion of Area 29 fished by Southern Vancouver Island and Gulf Island Indian Bands; and the lower Fraser River near the Agassiz-Rosedale bridge fished by the Cheam Indian Band.

2.2.3.1 Albion Test Fishery

The objective of the Albion test fishery, near Fort Langley, is to collect standardized catch per unit effort (CPUE) data and index chinook escapements to the Fraser River from April 1 to approximately late October. The test fishery has used a drifted gillnet that operates daily in one specific site in the Fraser River and fished on the rising tide following low slack since 1981. The test fishery historically used an 8 inch mesh net and has been limited to two consecutive sets per day.

As stated in Dempson et al. (1998), the Albion test fishery provides valuable information concerning the characteristics and run timing of chinook salmon to the Fraser River. The test fishery appears to detect subtle differences in stock characteristics throughout the run. Results from the test fishery are an "index" of abundance only, subject to variability and somewhat related to alternate estimates (e.g. aerial overflights, mark-recapture), some with unknown precision. Some limitations exist with the test fishery's ability to index the abundance of small timing groups, such as early-timed chinook, yet it adequately indexes larger timing aggregates, such as spring-run chinook.

To address the concern regarding the assumption that CPUE data in the test fishery are proportional to abundance of all size classes of chinook present, a multipanel net, fished on alternate days, was instituted in 1997. This net consists of repeating sections of 5, 6, 7, 8 and 9 inch mesh so that each mesh size occurs twice over the length of the net. The 8 inch mesh net is 150 fathoms long and the multipanel is 200 fathoms. One purpose for the inclusion of the smaller meshes in the multipanel net was to capture the smaller body size chinook typical of some systems such as Coldwater River and Spius Creek, that likely were not captured in proportion to their abundance in the 8 inch mesh net.

The test fishery samples chinook for CWTs whenever adipose fin clipped fish are encountered. Also, tissue for DNA analysis has been collected from nearly every chinook as part of the biological sampling conducted by the test fishery. Samples collected in 1995 from the 8 inch mesh have been analysed, but none since.

2.2.3.2 Historical Area 29 Commercial Fishery

For early-timed chinook, there were 29 years of mixed-population chinook catches from the Area 29 commercial fishery in the Fraser River. Catch data were determined from sales slips by Fisheries Management, Lower Fraser Area. However we could not determine population-specific catches from the historic data. The gillnet fishery that targeted chinook was closed in 1980.

2.2.3.3 WCVI Troll Fishery

For assessment purposes, the WCVI troll fishery was stratified into north (NWVI; Areas 125/126) and south (SWVI; Areas 123/124) areas. Fisheries Management, South Coast Area, estimated the total chinook catch from sales slips. Tissue samples were collected from chinook harvested during openings in April and May, and October and November in 1998 and 2000, for DNA analysis.

2.2.3.4 WCVI Recreational Fishery

Tissue samples were collected from the WCVI recreational fishery for DNA analysis and are yet to be analyzed. Since this fishery is essentially a summer fishery (June-September), it is highly unlikely that early-timed Fraser populations would be an important component in the catch since they will have migrated past WCVI before the fishery begins.

2.2.3.5 Victoria and Strait of Georgia Recreational Fishery

The Georgia Strait creel survey program provided catch estimates and collected tissue samples for DNA analysis. Tissue samples were collected from November 1999 until June 200 in the Victoria fishery, Areas 19B and 20, and from April to June 2000 from the Strait of Georgia fishery and were pooled by sampling location.

2.2.3.6 Fraser River Recreational Fishery

The majority of the Fraser River recreational fishery occurs in the lower river, and has opened in May since 1998. Catches were estimated by a creel survey (e.g. Palermo and Thompson 1999a). Catches are very low in May due to high flow in the Fraser River at that time, and no tissue samples were available for DNA analysis. Also, no tissue samples were available from the mixed-population fisheries near Lillooet or Spences Bridge.

2.2.3.7 Lower Fraser First Nations Fishery

Historical catches from the Area 29 First Nations fishery were available for the past 28 years. From 1997 to 2000, Fisheries Management, Lower Fraser Area has collected tissue samples and developed catch estimates from this fishery. For the lower Fraser First Nations fishery, tissue samples were pooled for fishery landing locations from Sawmill Creek to downstream of Port Mann Bridge. Similarly, catch estimates were summed for areas from Sawmill Creek to downstream of Port Mann Bridge.

3 Results and Discussion

3.1 Escapement Summaries

Escapement estimates, where available, were summarized and are provided for each of the selected populations in Appendix 3A.

While for some years there are multiple estimates for some systems, and in other years, no useful estimates were generated at all, we provide the range of reasonable estimates for each year. The most credible escapement estimates for each system, annually from 1986 to 2000 are presented in Figure 3.1 and summarized in Table 3.1. All the reported estimates are point estimates and none incorporate estimates of precision.

From 1986 to 2000, estimated escapements to the Coldwater River ranged between 230 and 1,332, and averaged 569. Escapements to Spius Creek varied between 100 and 565 and averaged 322. Reported escapements to the upper Chilcotin River ranged between 201 and 735, and

averaged 432, and the annual streamwalk estimates for Birkenhead River varied from 147 to 713, with a mean of 368.

While escapements to each system fluctuated widely, and escapements to all systems were low in 1999, no trends were apparent in the escapement data.

3.2 Mixed-Population Fisheries

3.2.1 Albion Test Fishery

The DNA analysis indicated chinook from mid- and upper-Fraser populations dominated the catch in April and May 1995, comprising over 50% of the sample (Appendix 4). The Chilcotin and Stuart/Nechako River populations were the main populations from the mid-Fraser region contributing 38% and 11% respectively in the April sample and 11% and 22% respectively for the May sample. Chinook from the lower Thompson River comprised 5% or less of the catch in April and May. North and South Thompson River populations comprised < 5% of the catch as well, as was observed in the lower Fraser First Nations fishery. Contributing approximately 2% of the sample, Birkenhead chinook were detected in the April sample only.

To provide stock identification of the Albion catches, particularly during the first three weeks of April, for comparison with the catches in the 8 inch mesh net and in the First Nations fishery, samples from the multi-panel net need to be analysed. Valuable information necessary to the assessment of the early-timed chinook populations will remain inaccessible until this task is completed. Further analyses are also required to evaluate the relationship between the CPUE of the multi-panel net and subsequent escapements of the various run timing components and stocks of different marine age composition.

For CWT recoveries, one Coldwater fish was caught in the first statistical week of May and one Birkenhead fish was caught in the second statistical week of April (Appendix 1D).

3.2.2 Historical Area 29 Gillnet Fishery

Annual March to June chinook catches were summarized between 1952 and 2000, and generally increased from March to June (Figure 3.2). Commercial catches fluctuated widely during this period. They trend downward between the 1950s and late 1970s, and catches in the 1950s and 1960s were about twice the average catches in the 1970s. March catches were variable and typically in the order of a few hundred, and occasionally exceeded 1,000 chinook. April catches were usually several thousand and were considerably lower in the 1970s than the 1950s and 1960s. May catches ranged from about 4,000 to 15,000 chinook and June catches ranged from about 6,000 to 30,000 chinook.

3.2.3 WCVI Troll fishery

Recent closures of the summer WCVI troll fishery and harvesting of chinook in the fall and winter periods have resulted in altered catch compositions for this fishery. The major contributor to the SWVI troll for both the April-May and October-November time periods was US populations comprising 32-87% of the catch; these fish were largely Puget Sound and Columbia River populations (Appendix 5). Generally, the stock composition of the NWVI troll is similar

to the SWVI troll with the exception of the May 2000 sample which had a lower estimated component of US origin fish (approximately 32%) than Fraser (50%).

Although Fraser River populations sometimes constituted a significant proportion of recent WCVI troll catches (Table 3.2), early-timed populations were not common in the catches. Birkenhead and Nicola (Spius and Coldwater chinook are jointly identified with Nicola stocks in DNA analyses) drainage fish were never identified in the catch. Some Chilcotin chinook were apparently caught in the SWVI troll fishery during 1998 and the NWVI troll fishery during the spring of 2000.

No CWTs were reported in the WCVI catches for the selected populations (Appendix 1D).

3.2.4 WCVI Recreational Fishery

Preliminary catch estimates outside the surf line in 1998, 1999, and 2000 were 4,177, 31,085, and ~35,000 fish (D. Lewis, DFO Stock Assessment, pers. com.). No CWTs from the selected populations were recovered in this fishery (Appendix 1B). DNA samples from these fish have not yet been analysed. Since this fishery is essentially a summer fishery (June-September), it is highly unlikely that the selected early-timed populations would be an important component in the catch since they will have migrated past the west coast by the time the fishery begins.

3.2.5 Victoria and Strait of Georgia Recreational Fishery

CWT recoveries were mainly Birkenhead (9) and Coldwater (7), with only one from Spius Creek (Appendix 1B). Birkenhead origin fish were mainly caught from the Howe Sound to Pender Harbour area, with one in Gabriola Passage, one off Victoria, and one off Campbell River. All CWT marked fish were caught between October 25 and April 14, with the exception of an immature fish in May off Campbell River. Of the eight CWT recoveries of Coldwater River and Spius Creek origin, four occurred in Area 20 (Juan de Fuca) between April 24 and June 28; two in Johnstone Strait in early June, one off Denman Island in late June, and the other from the tidal portion of the lower Fraser River at the end of July.

The Victoria recreational fishery was assessed from the analysis monthly tissue samples from November 1999 until June 2000 in area 19B and 20-5 (Appendix 6). US origin fish comprised 70-90% of chinook sampled until June when Canadian origin fish began to dominate the catch (Figure 3.3). Fraser River populations began showing up by February, increasing to 85% of the catch by June. Nicola drainage fish first occurred in April (~2%), then increased to ~6% of the catch in the following two months (Figure 3.4). There appears to be extremely low numbers of Birkenhead and Chilcotin populations in the Victoria recreational fishery. The selected populations did not appear to ever occur in the Strait of Georgia recreational fishery in significant numbers. However, many of the sample sizes were small and distributed over several months, so there is considerable uncertainty.

The Victoria and Strait of Georgia recreational fisheries harvested ~9,923 chinook from November 1999 to June 2000. Of these, 204 chinook were estimated to be of Nicola drainage origin, and 21 fish of Chilcotin origin (Table 3.3). Most of these fish were caught in June and presumably represent late migrating spring-run populations (i.e. not the populations focused on in this report). Some Coldwater River CWTs were recovered off Victoria in the spring and early

summer, between 1989 and 1995, however there have been none since (Appendix 1C). Nicola River CWTs are recovered much more frequently off Victoria in June, indicating that much of this harvest is likely on the later Nicola River population.

3.2.6 Fraser River Recreational Fishery

In some years the recreational fishery in the lower mainstem Fraser River catches large numbers of chinook. Harvests of chinook in 1995, 1996, 1997, and 1998 were 7,121, 3,262, 1,687, and 7,181 fish, respectively (Bratty et al. 1998, Walter et al., 1998, Palermo and Thompson 1999a, b). Since 1998, this fishery has opened in May, however, catches are low in May due to the high water flows in the Fraser River.

CWT recoveries were from the Spius Creek and Coldwater River populations and none were from the Birkenhead River population (Appendix 1B). From Mission to the Thompson/Fraser River confluence, Coldwater CWTs were reported from June 2 to July 15 and Spius Creek CWTs reported from June 22 to 30. Three CWT recoveries were recorded from the recreational fishery at Spuzzum Creek in 1995, when the fishery was closed. Presumably, these fish were recovered in the First Nations fishery and those data (from heads turned into Fred's Tackle in Vedder Crossing) were added to the First Nations fishery CWT data table in Appendix 1C. Several other recoveries in the Yale to Spuzzum area in 1995 may also be of First Nations origin, however we cannot, at this time, differentiate them from freshwater recreational fishery recoveries, therefore they were included with the Fraser River recreational recoveries.

In the Thompson River recreational fishery at Spences Bridge (targeting later Nicola fish), 30 CWTs of Coldwater and Spius Creek origin were reported. These tags likely represent most of the CWT recoveries of Spius Creek and Coldwater River chinook, as a creel survey there encourages anglers to surrender heads for decoding CWTs. In recent years, heads from over 90% of all adipose clipped fish landed were dissected for CWT recovery, and the pins decoded.

One of the 30 CWTs from Spences Bridge had no reported capture date other than July. Two were caught in 1990, one in 1993, eight were recovered in 1994 when the fishery operated for the last two weeks of July as adipose-clip only, four in 1995, four in 1996, none in 1997 or 1998, five in 1999 and six in the 2000 fishery. Recoveries of Spius and Coldwater CWTs occurred mainly in the earlier portion of the fishery, prior to July 24, although Spius and Coldwater CWTs have occurred in the Spences Bridge fishery as late as August 12, 2000 (Figure 3.5).

3.2.7 Lower Fraser First Nations Fishery

The historical First Nations fishery in Area 29 started annually in March (Figure 3.2). First Nations catches in April, May and June have increased since 1990, although they remain below the total catches (commercial gillnet plus First Nations) recorded for the 1950s and 1960s.

The DNA analysis of the early period of in-river fishery sampling (ending on or before April 18; and sometimes beginning as early as March 20) indicated the catch of Birkenhead, Nicola, and Chilcotin watersheds fish comprise from 51-73% of the total catch depending on the year (Appendix 7). The following week, ending April 24-26, the combined catch for these target populations decreased to between 29 and 48%. By the week ending May 8, Birkenhead fish were no longer observed in the catch, and by the week ending June 5-7, the Nicola and Chilcotin

drainage populations decreased to less than 20% of the total catch (Figure 3.6). By this time, other upper and mid-Fraser populations dominated the catch.

CWT recoveries can be useful in further interpretation of DNA results. A total of 33 CWTs of Coldwater River and Spius Creek origin were decoded from samples from the lower Fraser River First Nations drift gillnet fishing area and Yale Beach between 1995 and 2000 (Appendix 1C). Coldwater River and Spius Creek CWT recoveries were observed as early as March 20 1997, and as late as August 26 1998, although most (10) occurred between April 15 and 21 (Figure 3.7). The Nicola catch observed in the lower Fraser River First Nations fishery prior to mid May are almost certainly of Coldwater and Spius origin; Nicola River CWTs are not observed in the catches until early May and do not peak in abundance until June. Similarly, DNA estimates of stock composition show initially high Nicola drainage contributions, dropping sharply through late April and early May, then rising again from late May through early June.

Significant numbers of chinook from the Birkenhead, Nicola, and Chilcotin drainages appear to have been harvested in the lower Fraser First Nations fishery (Table 3.4). It also appears that large numbers of Stuart/Nechako fish were caught in the fishery, although these fish may have been possibly from Stuart drainage tributaries. Chinook from the Stuart/Nechako drainage are generally considered summer-run populations (DFO 1995). There may be an early-timed population(s), returning to the Stuart/Nechako system, that is absent from our baseline. It is also possible that some of the summer spawning fish migrate through the lower Fraser River early in the season and hold up somewhere en route.

3.3 Marine Catch Distributions

Some information on the marine distributions of the selected populations is available from recoveries of CWT marked fish in marine fisheries in British Columbia, Alaska, and Washington, as well as from the DNA analyses from the WCVI troll and Victoria and Strait of Georgia recreational fisheries. The selected populations have different marine distributions and appear to be vulnerable to different marine fisheries. For example Birkenhead chinook have been frequently caught in Alaska, while other spring-run populations have a more southerly distribution (DFO 1999).

Based on the CWT recoveries (Appendix 1D), the Birkenhead population appears to migrate far to the north and rear for an extended period in Alaskan and Northern B.C. waters. Most CWTs were reported from summer to early winter in the northwest and northeast troll fisheries. In Canadian marine waters, most commercial CWTs were recovered from the northern and central troll fisheries, and several were reported from the winter and early spring recreational fishery in the Georgia Basin. It appears that Birkenhead fish migrate from their ocean feeding grounds in Alaska, returning to the Strait of Georgia by March, and entering the Fraser shortly thereafter (Appendix 1B and D). This population appears to return by migrating south through Johnstone Strait and the Strait of Georgia to the Fraser River because it was not detected in the DNA samples from the Victoria recreational or WCVI troll fisheries (Appendix 5 and 6), and no CWTs of Birkenhead origin have been reported from these fisheries. Recoveries in the lower Fraser River decline sharply after April, indicating the population has passed all sampled fisheries, into the terminal area. These fish pass through First Nations fisheries in the lower Fraser River, Harrison River, Lillooet River and Lake, and Birkenhead River.

Only one Coldwater origin CWT was recovered in any commercial fishery samples, and eight Spius and Coldwater origin CWTs were recovered in marine recreational fisheries (Appendix 1B and D). The little marine CWT and DNA (Appendix 5 and 6) information we have for these stocks suggests a return migration route through the Strait of Juan de Fuca in March and early April, peaking into the Fraser River at that time. The actual site of ocean rearing is unclear, and the likelihood of determining that information is low due to the reductions in fisheries operating off WCVI and the smaller body size of these populations making many of them too small to retain in summer troll fisheries. These populations pass through First Nations fisheries in the lower Fraser, Fraser Canyon and any terminal fishery in the Nicola River, before arriving on the spawning grounds. Also intercepting these populations are recreational fisheries in the Fraser Canyon in May and the Thompson River recreational fishery in July.

Due to the lack of CWT release groups from upper Chilcotin, we must rely on CWT information from lower Chilcotin and DNA stock composition information to estimate its marine distribution. There are limited occurrences of any Chilcotin CWT recoveries or catches assigned to Chilcotin in marine areas based on DNA (Appendix 5 and 6). These mostly occur in the region of Juan de Fuca entrance or in U.S. waters to the south. Further, winter WCVI troll fishery and spring Juan de Fuca recreational fishery samples indicate very small contributions of Chilcotin fish (<3%). In-river recoveries appear substantial in comparison: estimated catches in the lower Fraser First Nations fishery from 1997 to 1999 ranged between 130 and 534 for the period up to April 19. Therefore, it appears that most exploitation on this population occurs after returning to freshwater.

3.4 Apparent Exploitation Rates

The available stock assessment information indicated the lower Fraser First Nations fishery was the largest source of harvest mortality for the selected early-timed populations, representing about 87% of the total estimated harvest (Table 3.5). Next was the Victoria and Strait of Georgia recreational fishery (8%) and the remaining fisheries represented about 5% of the total harvest.

The apparent exploitation rate was 33% for the four early-timed populations (pooled) based on the total harvest (868; Table 3.5) and escapement estimates (1,752; Table 3.1). The apparent exploitation rate may be a minimum since some fisheries were not sampled and we are without catch estimates. Also, some error would be attributed to estimating harvests for early-timed populations in the Chilcotin and Nicola watersheds from the DNA analysis.

As noted earlier, harvest estimates were limited to the end of April in order to reduce the influence of including the other spring-run populations in the Chilcotin and Nicola watersheds in the harvest estimate. This cut off was determined by the apparent declines in numbers of the early run populations toward the end of April, combined with observed CWT recoveries for the lower Chilcotin and Nicola populations in May. Truncating the estimates of early returning stocks in this manner likely leads to an underestimate of total exploitation, however, this underestimate is likely less than the overstimate that would occur due to the arrival of the more numerous, later run stocks from the Nicola and Chilcotin drainages.

3.5 Stock Status and Prognosis

This report has focussed on four populations in the earliest component of the spring-run aggregate returning to the Fraser River watershed. Stock status was inferred from spawner escapement estimates; however these estimates are of unknown precision and the time series is short. It is not possible to state definitively what the status of these populations is.

There is some weak evidence to support the notion that population sizes have declined. Survival rates for many stocks of chinook salmon in the Pacific Northwest are substantially lower than they were in the 1980's (CTC 1999). Commercial fisheries for chinook were cancelled after 1981 and in the 1950's and 1960's significant catches of chinook were recorded (Westrheim 1998). Mean catch during March to May from 1958 to 1969 was 11,400 chinook. We can only assume that populations considered in this report were comprised of these fish, at least in part.

Many chinook salmon populations returning to the Fraser River during summer have increased in recent years (DFO 1999) while escapement estimates of the four early-timed populations have been without trend (Figure 3.1). While the status of the early-timed populations is uncertain, the escapements to the four selected populations were small, and there is an increasing likelihood that conservation concerns may develop if populations become much smaller.

4 Summary and Conclusions

- Although the time series of reliable spawner escapement was short for the selected populations, recent data demonstrate that fewer than 250 spawners returned to these systems on several occasions, and escapements as low as 109 were observed in 1999. These escapements are probably inadequate to fully utilize the systems. Habitat-based assessments of the carrying capacity of these systems would help us understand their potential.

- Recent DNA derived stock composition estimates and catch data indicate that few fish from the selected populations were harvested in Canadian marine fisheries. These data are corroborated by the extremely low numbers of CWT recoveries. Catches in the WCVI and lower Fraser River recreational fisheries usually are not significant prior to June, after most early-timed populations have migrated past. Some chinook from the Chilcotin drainage were caught in the April and May WCVI troll fishery but numbers were small and estimates were of relatively low precision. CWT recoveries indicate some Birkenhead fish are caught in Alaskan fisheries. Larger catches of Nicola and Chilcotin drainage chinook occurred in May and June in the Victoria and Strait of Georgia recreational fishery (as determined by DNA), but the catches in May and June are assumed to be mostly later migrating spring-run populations.

- In the early 1950's, in-river catches of Fraser chinook in the March to April period averaged nearly 6,500. Most of this catch occurred in the commercial gillnet fishery, however this fishery has been closed since 1980. Recent in-river catches are much less, although trending up.

- It appears that significant numbers of early-timed chinook are caught in the lower Fraser First Nations fishery from March to April. Catches up to the end of April are considered to be entirely early-timed populations in those drainages, indicating catches of 115-219 Coldwater and Spius fish, 56-159 Birkenhead fish, and 148-603 upper Chilcotin fish from 1997 to 1999. Preliminary March and April catch estimates for 2000 also indicate significant catches of the stocks of concern. While the escapement estimates are of modest quality, apparent exploitation rates (estimated using DNA evidence) for the period until the end of April may be exceeding 33%. Exploitation rates are likely greater since catch estimates were not available for several fisheries.

- DNA analyses indicate a high catch of Stuart/Nechako fish in the spring samples from the lower Fraser First Nations fishery. Previous investigations indicated all chinook arrive and spawn in the Stuart/Nechako during summer (DFO, FRAP 1995), although recent discussions with the Tl'azt'en First Nation indicated some chinook spawn in Stuart tributaries, such as Kazchek Creek, Kuzkwa River and Pinchi Creek, in late July. Additional survey work is required to assess the size of these populations, which have not been included in the Fraser escapement record or our chinook DNA baseline.

- We were unable to provide accurate in-river harvest estimates for Birkenhead population because catch data were not separated upstream and downstream of the Harrison/Fraser confluence. Further, an active First Nations fishery exists in the Birkenhead River and Lillooet Lake and River that is not adequately sampled. The Birkenhead fish have the earliest run timing of all Fraser chinook salmon. The spatial and temporal separation of the Birkenhead population may be responsible for making it one of the most genetically distinctive Fraser chinook populations.
- The populations investigated numerically constitute a relatively minor component of the chinook returning to the Fraser River watershed. Stock assessment information for other populations of interior Fraser chinook needs to be assembled and reviewed.

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7 Tables

Table 3.1. "Best" and mean escapement estimates to Coldwater River, Spius Creek, upper Chilcotin River and Birkenhead River, 1986 to 2000.

Year	Coldwater River	Spius Creek	Upper Chilcotin	Birkenhead River
1986	450	425	no usable est.	no usable est.
1987	450	425	500	no usable est.
1988	220	120	400	no usable est.
1989	1050	565	no usable est.	no usable est.
1990	325	100	no usable est.	no usable est.
1991	325	248	no usable est.	242
1992	1332	250	no usable est.	713
1993	800	365	no usable est.	241
1994	400	162	450	343
1995	700	500	262	162
1996	no usable est.	500	735	293
1997	735	no usable est.	360	573
1998	230	300	618	565
1999	230	109	285	147
2000	715	432	201	404
Mean	569	322	423	368

Table 3.2. Chinook salmon harvest estimates for the WCVI troil fishery for southern (SWVI) and northern (NWVI) areas from April 1998 to April 2000.

SWVI	April/May 1998		April/May 2000		Oct/Nov 1998		Oct/Nov 1999	
	Harvest	SD	Harvest	SD	Harvest	SD	Harvest	SD
Birkenhead	0	0	0	0	0	103	0	0
Cold/Nicola/Spius	0	0	0	12	0	78	0	0
Low/Upp Chilcotin	32	21	0	0	54	167	0	0
All Fraser	49	53	568	109	500	319	8036	1252
All Canada	163	80	854	142	2151	622	12279	1705
All US	1125	80	2102	142	2749	622	22507	1705

NWVI	April/May 1998		April 2000		May 2000		Oct/Nov 1998		Oct/Nov 1999	
	Harvest	SD	Harvest	SD	Harvest	SD	Harvest	SD	Harvest	SD
Birkenhead	0	0	0	0	0	0	0	0	0	0
Cold/Nicola/Spius	0	17	0	5	0	0	0	4	0	0
Low/Upp Chilcotin	0	29	4	5	21	12	0	2	0	0
All Fraser	399	116	168	34	826	48	188	73	5763	763
All Canada	804	191	239	35	1127	45	373	109	8031	975
All US	2088	191	362	35	525	45	1413	109	13158	1038

Table 3.3. Monthly total chinook catch estimates and estimates of total harvest (Est) of Birkenhead, Nicola drainage, and Chilcotin fish by Statistical Area, and landing site for the Strait of Georgia and Victoria recreational fisheries. Stock compositions (%) taken from Appendix 6 for month and landing sites where available.

Statistical Area	Date	Catch Estimate	Landing Site	Birkenhead		Nicola		Chilcotin	
				%	Est	%	Est	%	Est
13	Apr. 2000	15	Campbell River	-	-	-	-	-	-
13	May 2000	16	Campbell River	0.0	0	.4	1	0.0	0
13	June 2000	1,474	Campbell River	0.0	0	.4	6	0.0	0
14	Apr. 2000	33	Nanaimo	-	-	-	-	-	-
14	May 2000	70	Campbell River Nanaimo	-	-	-	-	-	-
14	June 2000	534	Campbell River Comox Nanaimo	0.0	0	.4	2	-	-
16	Apr. 2000	77	Sechelt	0.0	0	0.0	0	0.0	0
16	May 2000	54	Sechelt Powell River	0.0	0	0.0	0	0.0	0
16	June 2000	65	Sechelt	0.0	0	0.0	0	0.0	0
17	Apr. 2000	148	Nanaimo	-	-	-	-	-	-
17	May 2000	117	Nanaimo	-	-	-	-	-	-
17	June 2000	482	Nanaimo	0.0	0	1.9	9	0.0	0
19	Nov./Dec. 1999	1,296	Victoria	0.0	0	0.0	0	0.0	0
19	Jan. 2000	1,003	Victoria	0.0	0	0.0	0	0.0	0
19	Feb. 2000	640	Victoria	0.0	0	0.0	0	0.4	3
19	Mar. 2000	151	Victoria	0.0	0	0.0	0	0.0	0
19	Apr. 2000	87	Victoria	0.0	0	2.1	2	0.0	0
19	May 2000	640	Victoria	0.0	0	6.1	40	0.0	0
19	June 2000	2,181	Victoria	0.0	0	6.6	144	0.8	18
28	Apr. 2000	249	Sechelt Vancouver	0.0	0	0.0	0	0.0	0
28	May 2000	43	Sechelt Vancouver	0.0	0	0.0	0	0.0	0
28	June 2000	74	Sechelt Vancouver	0.0	0	0.0	0	0.0	0
29	Apr. 2000	249	Vancouver	0.0	0	0.0	0	0.0	0
29	May 2000	115	Vancouver	0.0	0	0.0	0	0.0	0
29	June 2000	110	Vancouver	-	-	-	-	-	-
Total		9,923			0		204		21

Table 3.4. Harvest estimates for Birkenhead, Nicola drainage, Chilcotin drainage, and Nechako/Stuart chinook populations in the lower Fraser First Nations fishery from 1997 to 1999. Standard deviation is in parentheses and was estimated from the variance in the stock composition estimates (Appendix 7).

	Estimated Total Catch			Estimated Harvests From Birkenhead Population			Estimated Harvests From Coldwater/Nicola/Spius Populations			Estimated Harvests From Lower/Upper Chilcotin Populations			Estimated Harvests From Nechako/Stuart Populations		
	1997[1]	1998[1]	1999[1]	1997	1998	1999	1997	1998	1999	1997	1998	1999	1997	1998	1999
<April 19[2]	1,653 (-)	716 (-)	374 (-)	119 (48)	60 (18)	45 (10)	184 (93)	176 (38)	97 (19)	534 (103)	217 (44)	130 (22)	323 (107)	115 (42)	32 (17)
April 24-26	370 (-)	124 (-)	131 (-)	15 (16)	11 (7)	2 (1)	35 (22)	17 (9)	18 (3)	69 (38)	33 (14)	18 (4)	0 (21)	0 (8)	17 (5)
May 2-3	466 (-)	166 (-)	230 (-)	25 (14)	7 (5)	0 (0)	34 (25)	27 (12)	36 (14)	65 (36)	16 (10)	42 (14)	32 (31)	9 (13)	49 (18)
May 8-10	639 (-)	270 (-)	615 (-)	NA	0 (0)	0 (0)	NA	41 (16)	175 (30)	NA	29 (11)	143 (28)	NA	24 (13)	84 (31)
May 15-17	290 (-)	725 (-)	1,085 (-)	NA	4 (8)	0 (0)	NA	98 (29)	272 (51)	NA	142 (33)	202 (48)	NA	42 (49)	98 (48)
May 22-24	685 (-)	1,010 (-)	855 (-)	NA	0 (8)	9 (13)	NA	98 (28)	263 (42)	NA	123 (37)	114 (37)	NA	98 (48)	132 (47)
May 29-31	772 (-)	930 (-)	284 (-)	NA	0 (0)	0 (0)	NA	91 (34)	78 (27)	NA	45 (23)	13 (16)	NA	34 (34)	8 (16)
June 5-7	941 (-)	1,533 (-)	738 (-)	NA	0 (0)	0 (0)	NA	64 (40)	97 (26)	NA	49 (29)	19 (13)	NA	74 (51)	69 (41)
June 12-14	1,850 (-)	2,085 (-)	1,024 (-)	NA	0 (0)	0 (0)	NA	171 (52)	127 (33)	NA	17 (38)	86 (22)	NA	0 (0)	145 (40)
June 19-21	2,384 (-)	1,959 (-)	809 (-)	NA	0 (0)	0 (0)	NA	59 (29)	66 (19)	NA	63 (51)	84 (24)	NA	0 (51)	37 (28)
>June 27[3]	2,038 (-)	993 (-)	4,706 (-)	NA	0 (7)	0 (0)	NA	60 (51)	311 (127)	NA	65 (46)	569 (198)	NA	60 (51)	339 (231)
Total	12,088 (-)	10,511 (-)	10,851 (-)	159 (52)	83 (24)	56 (16)	252 (98)	901 (111)	1,540 (157)	668 (115)	797 (111)	1,420 (214)	364 (113)	455 (125)	1,008 (252)

1. (-) indicates no standard deviation estimates available.
2. Time period includes catches from the weeks ending March 21-23 to April 19.
3. Time period includes catches from the weeks ending June 27-28 for 1997 and 1998, and from June 27 to July 4 for 1999.

NA indicates periods without genetic stock composition estimates from First Nations catches.

Table 3.5. Preliminary estimates of catches of Birkenhead River, Nicola drainage, and Chilcotin drainage chinook in 2000.

Time Period	WCVI Troll[1]	Victoria and Strait of Georgia Recreational[2]	Fraser River Recreational[3]	Lower Fraser First Nations[3]	Albion Test Fishery[3]
January 2000	No fishery	0	No fishery	No fishery	No fishery
February 2000	No fishery	3	No fishery	No fishery	No fishery
March 2000	No fishery	0	No fishery	162	No fishery
April 2000	4	2	No fishery	672	25
May 2000	21	41	15	944	22
June 2000	No fishery	179	27	826	37
Oct.-Apr. Total (%)	4 (<1%)	5 (<1%)	0 (0%)	834 (96%)	25 (3%)
Oct.-June Total (%)	25 (1%)	225 (8%)	42 (1%)	2604 (87%)	84 (3%)

1. From Table 3.2. WCVI troll fishery took place in October and November, 1999 and the estimated catch from the selected populations was 0 fish.
2. From Table 3.3. Victoria recreational fishery was sampled in November and December and the estimated catch from the selected populations was 0 fish.
3. Calculated from 2000 catches. Stock composition was averaged from 1997 to 1999 First Nations fisheries because 2000 genetic samples have yet to be analyzed. March 2000 First Nations estimate calculated from 2000 catch and 1997 to 1999 stock composition average for April.

8 Figures

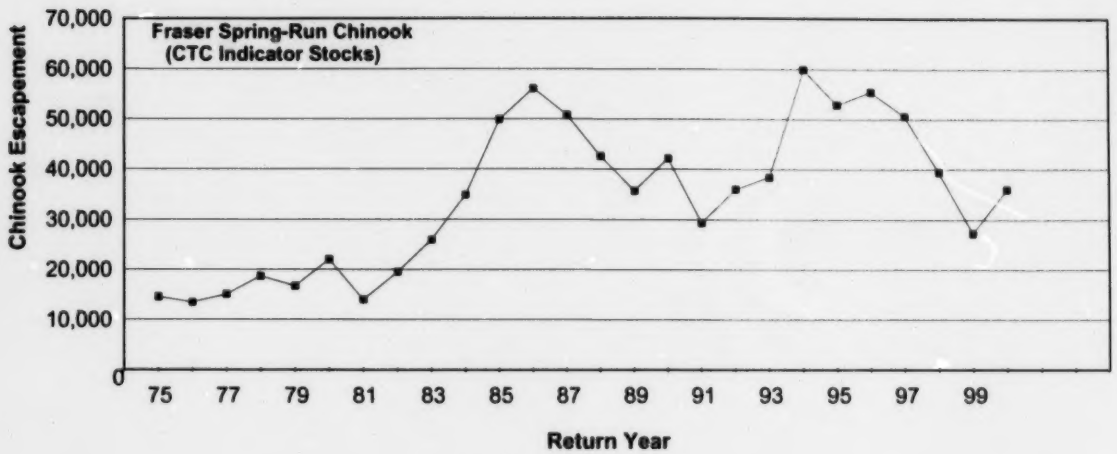


Figure 1.1. Time series of chinook escapements for the Chinook Technical Committee (CTC) populations in the Fraser River spring-run aggregate. Populations included in the CTC spring-run aggregate are defined in Figure 2.1.

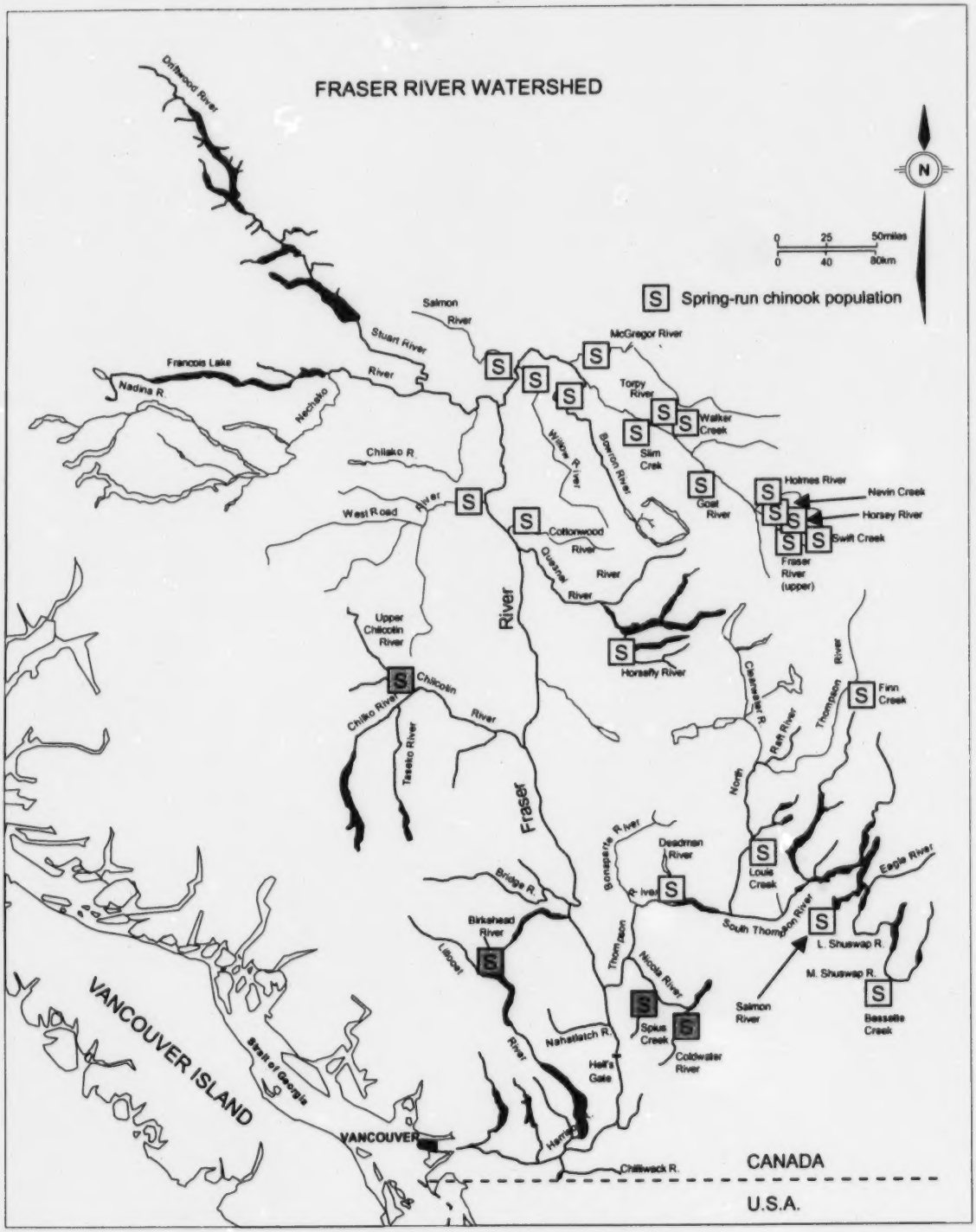
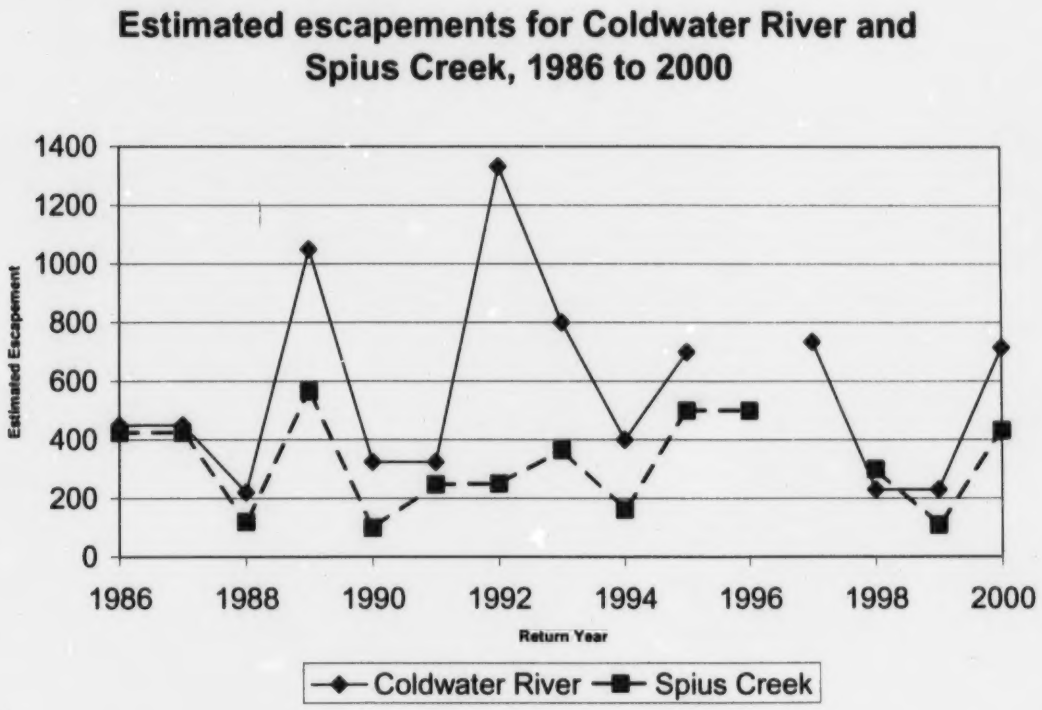


Figure 2.1. Locations of chinook populations included in the Fraser River spring-run aggregate. Shaded boxes indicated the populations considered in this report.

(a)



(b)

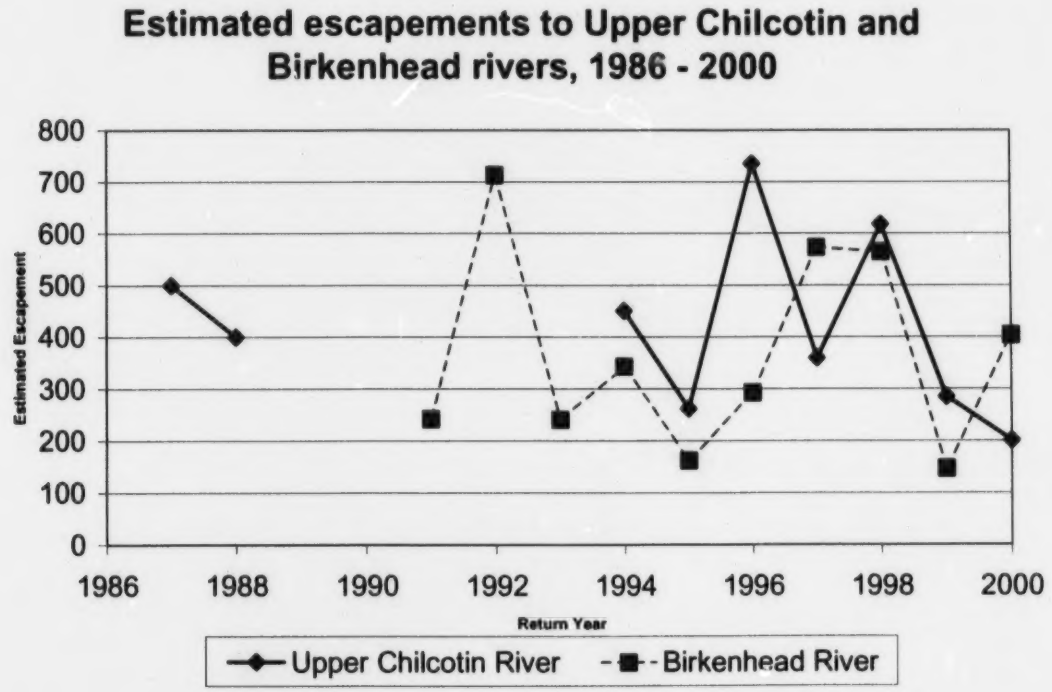


Figure 3.1. Estimated escapements to Spius Creek and Coldwater River (a), and upper Chilcotin and Birkenhead rivers (b), 1986 to 2000.

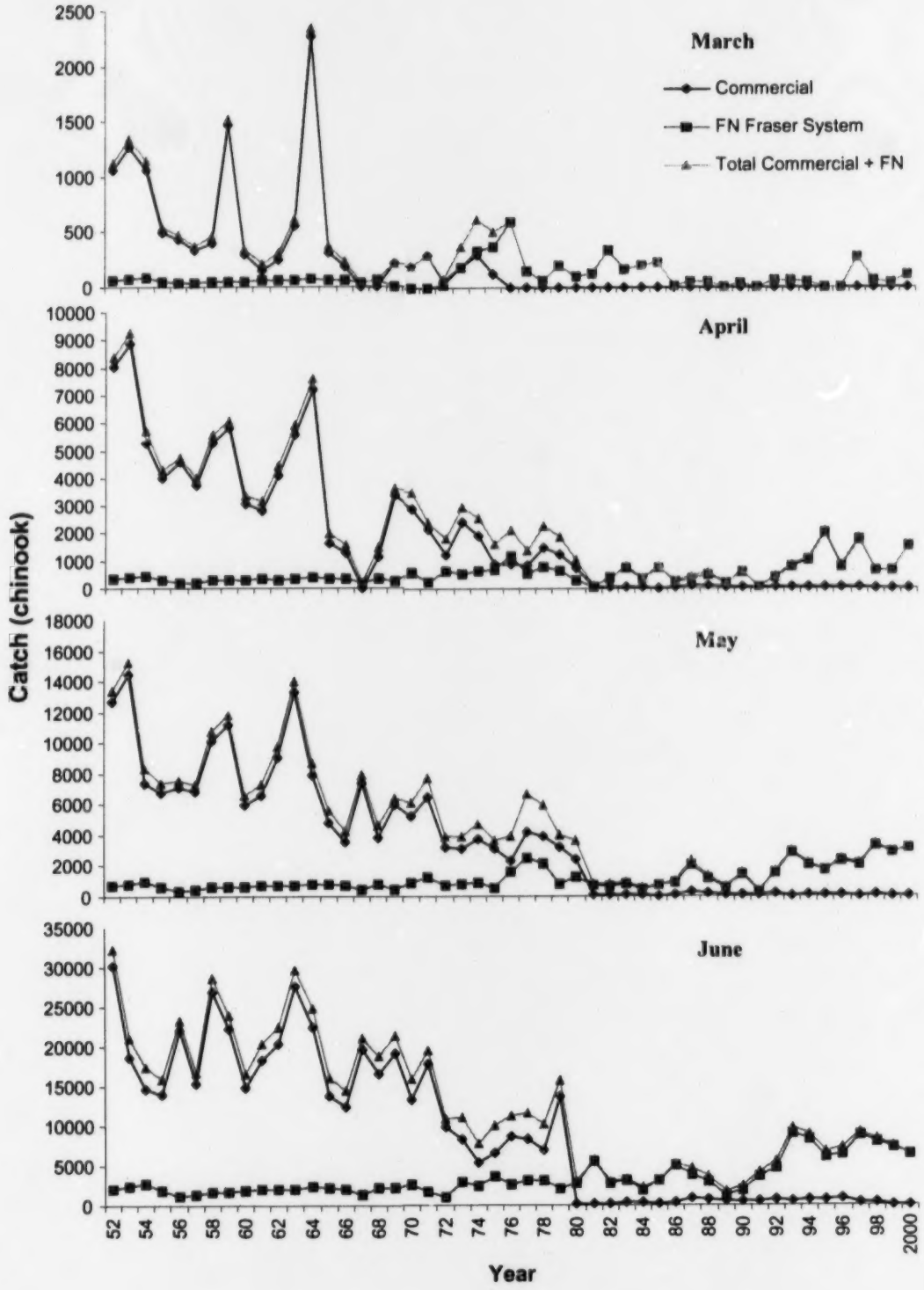


Figure 3.2. Historical chinook catches in the Area 29 commercial and First Nations fisheries, 1952 to 2000.

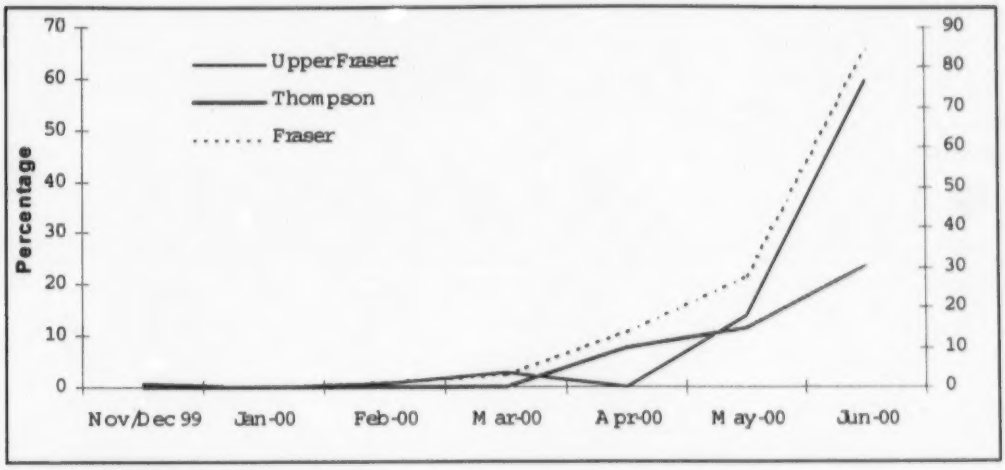


Figure 3.3. The percentages of upper Fraser, Thompson and all Fraser chinook stocks in the recreational fishery samples at Victoria (Statistical Area 19) determined from DNA analysis. The percentages of all Fraser stocks are plotted on the secondary (i.e. right) axis.

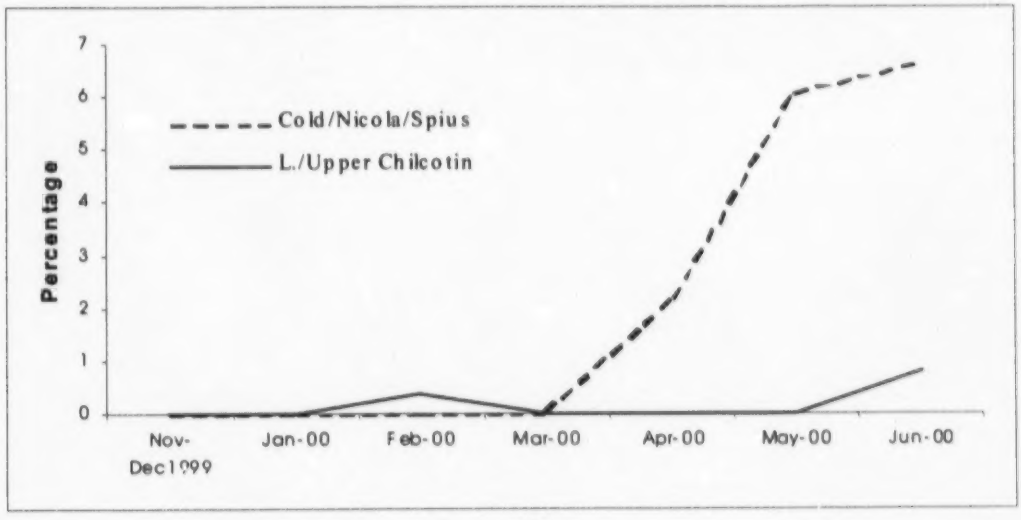


Figure 3.4. The percentages of Coldwater/Nicola/Spius and Lower/Upper Chilcotin chinook stocks in the recreational fishery samples at Victoria (Statistical Area 19) determined from DNA analysis. Birkenhead population not detected in mixtures.

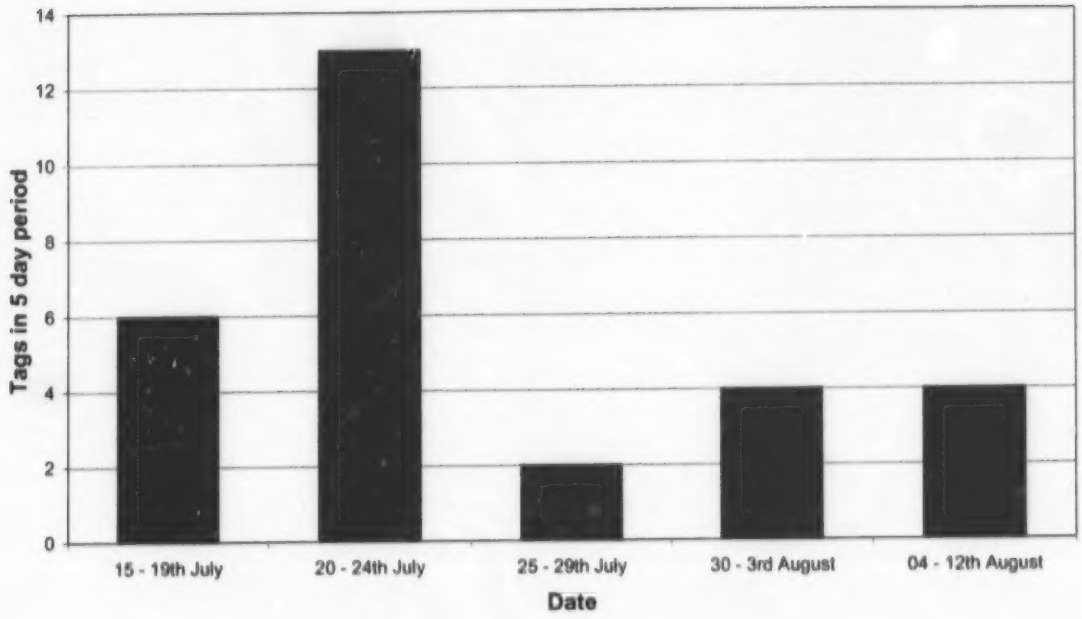


Figure 3.5. Observed CWT recoveries of Coldwater River and Spius Creek in the Spences Bridge recreational fishery, 1993 to 2000.

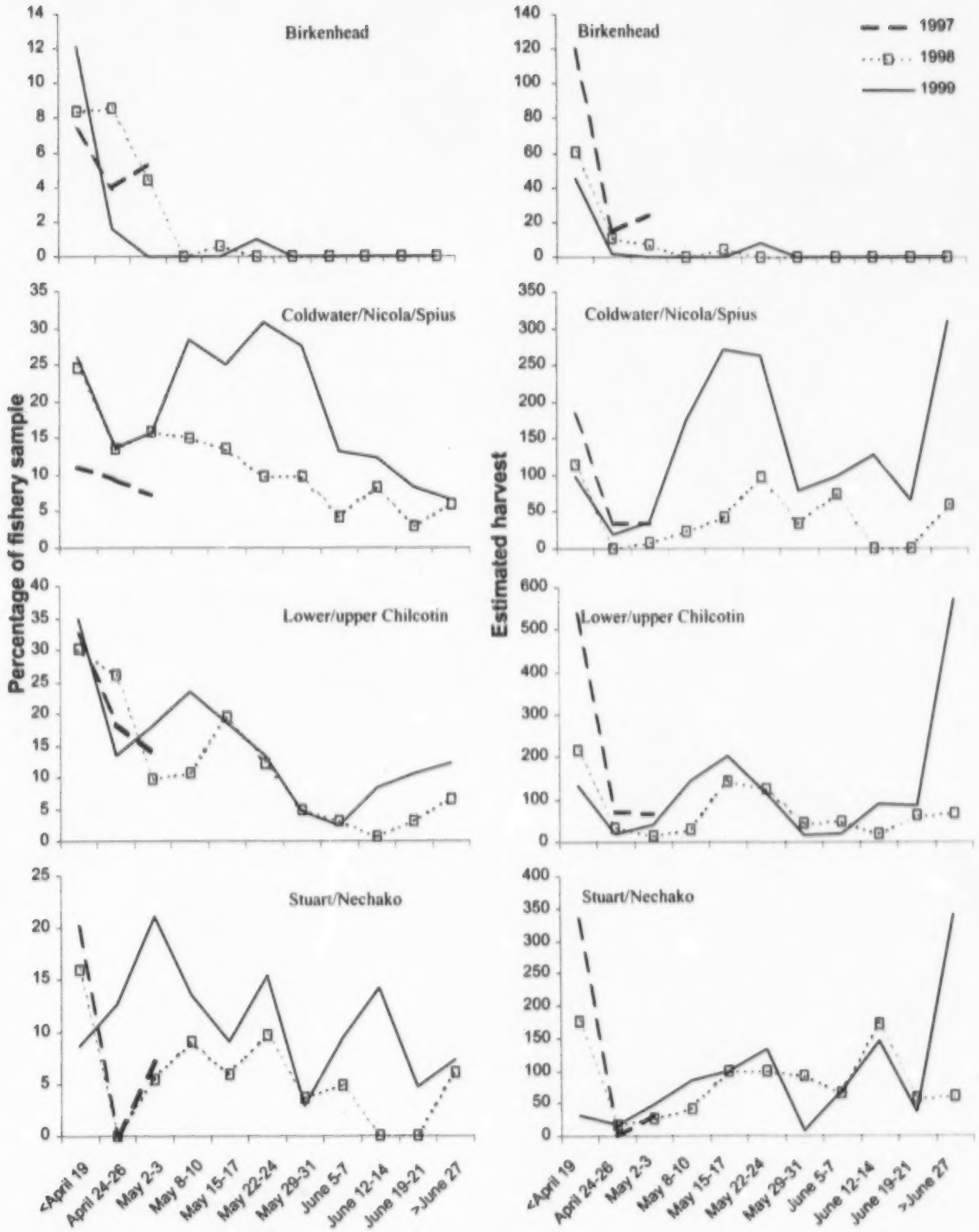


Figure 3.6. The percentage of the lower Fraser First Nation fishery sample (left hand panels) and estimated harvests (right hand panels) of: Birkenhead, Coldwater/Nicola/Spius, lower/upper Chilcotin, and Stuart/Nechako drainage stocks. Standard deviations for the percentages of the fishery sample and estimated harvest are in Appendix 5).

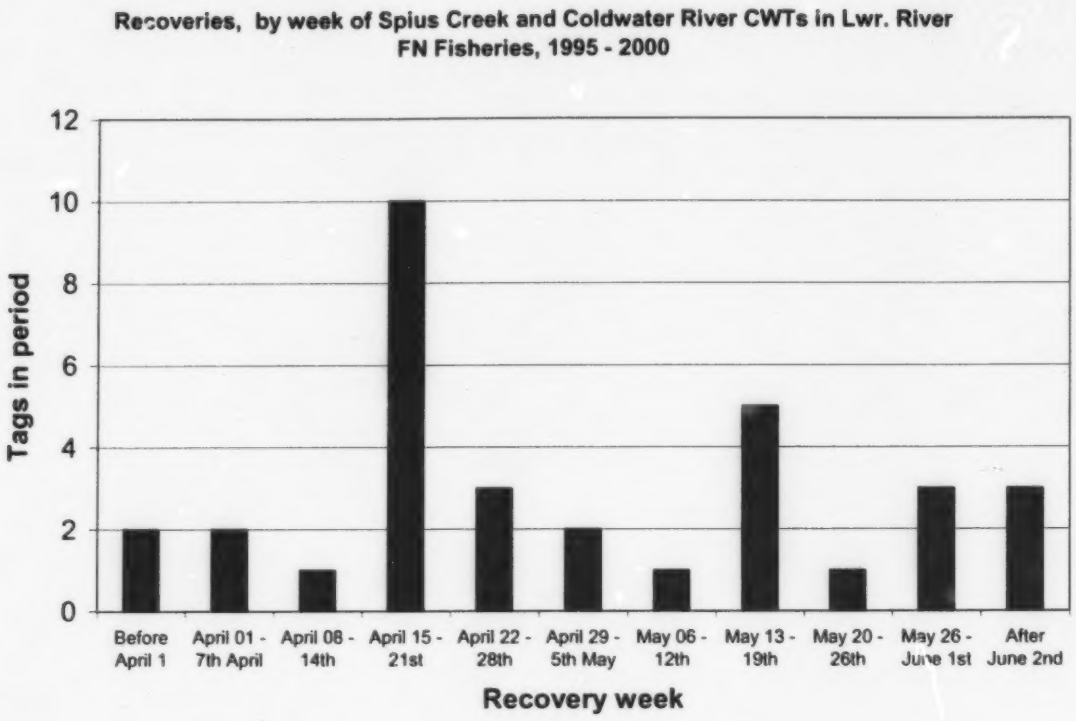


Figure 3.7. Observed CWT recoveries, by week of Coldwater River and Spius Creek in the lower Fraser First Nations fishery, 1995 to 2000.

9 Appendices

Appendix 1A. CWT releases and observed recoveries for Spius Creek, Coldwater River and Birkenhead River for brood years 1984 to 1996.

Stock	Tagcode	Brood Year	No. tags released	Rel. Stage	Recovery Year(s)	Observed Recoveries		
						Ocean	FW	Escapement
Spius Creek								
	181226	1992	47,264	smolt	1996 - 1997	0	4	11
	182734	1995	47,160	smolt	1998 - 2000	0	6	1
	183352	1996	49,201	smolt	1999 - 2000	1	9	0
	Total		143,625			1	19	12
Coldwater River	022817	1984	22,227	fed fry	1986 - 1988	1	0	10
	022818	1984	41,073	fed fry	1987 - 1988	1	0	14
	024607	1986	50,787	fed fry	1989 - 1990	2	3	16
	025517	1988	50,416	fed fry	1990 - 1992	1	1	7
	020742	1989	24,961	smolt	1993	0	1	25
	020743	1989	25,032	smolt	1992 - 1993	2	0	29
	180301	1990	24,815	smolt	1994	2	5	14
	180302	1990	24,920	smolt	1993 - 1995	1	5	21
	180850	1991	71,767	smolt	1995 - 1996	1	26	45
	181225	1992	47,561	smolt	1996 - 1997	0	0	4
	181754	1992	22,547	smolt	1995 - 1996	1	0	3
	180857	1993	20,423	smolt	1997	0	2	7
	181525	1994	20,826	smolt	1998	0	2	12
	181526	1994	21,241	smolt	1998	0	0	8
	182241	1994	25,608	smolt	1998	0	2	5
	183350	1995	41,059	smolt	1999	0	10	0
	Total		535,263			12	57	220
Birkenhead River	023234	1984	35,398	fed fry	1988 - 1989 1986, 1988	4	0	7
	023235	1984	35,846	fed fry	- 1989	3	0	11
	023318	1984	23,487	fed fry	1989 - 1990	1	0	1
	023319	1984	17,671	fed fry	1989	0	0	1
	023713	1985	49,460	fed fry	1987 - 1991	5	0	4
	023714	1985	42,543	fed fry	none	0	0	0
	024320	1986	48,150	fed fry	none	0	0	0
	024321	1986	50,695	fed fry	1990 - 1991	6	0	1
	024725	1987	24,400	fed fry	1991	1	0	0
	024726	1987	24,433	fed fry	none	0	0	0
	025408	1988	50,833	fed fry	1991 - 1993	9	0	0
	025840	1988	23,287	fed fry	none	0	0	0
	025841	1988	23,849	fed fry	none	0	0	0
	025842	1988	23,538	fed fry	none	0	0	0
	020732	1989	25,184	fed fry	none	0	0	0
	020733	1989	25,067	fed fry	1993	0	0	1
	020734	1989	24,977	fed fry	1993 - 1995	8	0	6
	020735	1989	25,042	fed fry	1993 - 1994	7	0	9
	021463	1990	25,197	fed fry	1994 - 1995	3	0	7
	021527	1990	42,686	fed fry	none	0	0	0
	180728	1991	27,125	smolt	1994	1	0	0
	180738	1992	16,900	smolt	1996 - 1997	4	0	0
	181514	1995	40,392	smolt	1999 - 2000	17	0	0
	Total		726,160			69	0	48

Appendix 1B. Observed recreational fishery CWT recoveries of Coldwater River, Spius Creek, and Birkenhead River chinook, 1989 to 2000.

Recovery Year	Tagcode	Sport Location	Stat Area	Lat	Long	Recovery Date	Observed Recoveries
Coldwater River							
1993	020743	MALCOLM ISLAND	012	5038	12653	Jun-06	1
1994	180301	JOHNSTONE BLUFF	013	5021	12506	Jun-05	1
1989	024607	BEECHEY HEAD	020	4818	12340	Jun-28	1
1993	020743	CHURCH ISLAND	020	4818	12335	Apr-24	1
1994	180301	CHURCH ISLAND	020	4818	12335	May-07	1
1995	180850	CHURCH ISLAND	020	4818	12335	May-24	1
1994	180302	FRASER:BROWNSVILLE	029	4910	12240	Jul-31	1
1989	024607	FRASER:ABOVE MISSION	0FW	4909	12215	Jul-07	1
1990	024607	THOMPSON:SPENCES BR	0FW	5025	12121	July - day unk	1
1990	024607	THOMPSON RIVER	0FW	5041	12020	Aug-05	1
1990	025517	FRASER:ABOVE HOPE	0FW	4900	12100	Jul-09	1
1993	020742	THOMPSON RIVER	0FW	5041	12020	Jul-17	1
1994	180301	NICOLA RIVER	0FW	5026	12119	both Jul-23	2
1994	180301	THOMPSON RIVER	0FW	5041	12020	Jul-17	1
1994	180301	THOMPSON RIVER	0FW	5041	12020	Jul-25	1
1994	180302	THOMPSON RIVER	0FW	5041	12020	Jul-18, -23	2
1994	180302	THOMPSON RIVER	0FW	5041	12020	Jul-24	1
1994	180302	THOMPSON RIVER	0FW	5041	12020	Jul-31	1
1995	180850	FRASER:ABOVE MISSION	0FW	4909	12215	Jun-18	1
1995	180850	FRASER:ABOVE MISSION	0FW	4909	12215	Jun-30	1
1995	180850	FRASER:SPUZZUM CREEK	0FW	4940	12125	Jun-02	1
1995	180850	FRASER:YALE	0FW	4934	12126	Jun-04	1
1995	180850	NICOLA RIVER	0FW	5026	12119	Jul-15	1
1995	180850	NICOLA RIVER	0FW	5026	12119	Jul-18	1
1995	180850	THOMPSON RIVER	0FW	5041	12020	both Jul-22	2
1996	180850	THOMPSON:SPENCES BR	0FW	5025	12121	Jul-20	1
1996	180850	THOMPSON RIVER	0FW	5041	12020	Jul-22	1
1997	180857	FRASER:ABOVE MISSION	0FW	4909	12215	Jun-23	1
1999	183350	FRASER:YALE	0FW	4934	12126	Jun-02	1
1999	183350	FRASER:YALE	0FW	4934	12126	Jun-29	1
1999	183350	FRASER:WINGDAM BAR	0FW	4911	12201	Jul-15	1
1999	183350	THOMPSON RIVER	0FW	5041	12020	Jul-31, Aug-1	2

Appendix 1B cntd. Observed recreational fishery CWT recoveries of Coldwater River, Spius Creek, and Birkenhead River chinook, 1989 to 2000.

Recovery Year	Tagcode	Sport Location	Stat Area	Lat	Long	Recovery Date	Observed Recoveries
Spius Creek							
2000	183352	DENMAN ISLAND	014	4935	12445	Jun-28	1
1996	181226	THOMPSON:SPENCES BR	0FW	5025	12121	Jul-20	1
1996	181226	THOMPSON:SPENCES BR	0FW	5025	12121	Jul-22	1
1999	182734	FRASER:YALE	0FW	4934	12126	Jun-22, -26	2
1999	182734	NICOLA RIVER	0FW	5026	12119	Jul-31, Aug-01	2
1999	183352	NICOLA RIVER	0FW	5026	12119	Aug-08	1
2000	183352	NICOLA RIVER	0FW	5026	12119	Aug-12	1
2000	183352	THOMPSON:SPENCES BR	0FW	5025	12121	Aug-05	1
2000	183352	NICOLA RIVER	0FW	5026	12119	Jul-29	1
2000	183352	THOMPSON:SPENCES BR	0FW	5025	12121	Jul-23	1
2000	183352	THOMPSON:SPENCES BR	0FW	5025	12121	Jul-22	2
2000	183352	CHILLIWACK R. MOUTH	0FW	4911	12157	Jun-30	1
Birkenhead River							
1989	023235	ALBERT HEAD	19B	4823	12329	Mar-18	1
1991	024321	HULKS	015	4952	12434	Feb-07	1
1991	024321	SARGEANT BAY	029	4928	12351	Feb-24	1
1992	025408	HULKS	015	4952	12434	Oct-25	1
1993	025408	HUTT ISLAND	028	4925	12323	Jan-17	1
1994	180728	SALMON POINT	014	4953	12507	May-29	1
1994	020735	GABRIOLA PASSAGE	017	4908	12343	Mar-14	1
1994	020734	GIBSONS LANDING	028	4923	12330	Apr-14	1
1999	181514	BEHM CANAL, AK	020	4818	12340	Jun-13	1

Appendix 1C. Observed CWT recoveries of Coldwater River and Spius Creek chinook in the lower Fraser First Nations fishery, 1995 to 2000.

Recovery Year	Tagcode	Fishery Location	Stat Area	Recovery Date	Observed Recoveries
Coldwater River					
1995	180850	Katzie Landing Station	0FW	13-May-95	1
1995	180850	Katzie Landing Station	0FW	22-Apr-95	2
1995	180850	Katzie Landing Station	0FW	29-Apr-95	1
1995	180850	Katzie Landing Station	0FW	8-Apr-95	1
1995	180850	Katzie Landing Station	0FW	20-May-95	1
1995	180301	Katzie Landing Station	0FW	15-Apr-95	1
1995	180302	Katzie Landing Station	0FW	15-Apr-95	1
1995	180850	Fraser:Spuzzum Creek	0FW	May-28, 29, 30	3
1996	180850	Lower Fraser FN Gillnet	0FW	5-May-96	1
1996	180850	Bowmans Mill	0FW	17-Apr-96	1
1996	180850	Lower Fraser FN Gillnet	0FW	7-Apr-96	1
1996	180850	Lower Fraser FN Gillnet	0FW	11-May-96	1
1996	180850	Coquihalla	0FW	15-Apr-96	1
1996	180850	Lower Fraser FN Gillnet	0FW	7-Apr-96	1
1996	180850	Lower Fraser FN Gillnet	0FW	28-Apr-96	1
1997	180857	Lower Fraser FN Gillnet	0FW	20-Mar-97	1
1998	181525	Fraser R. Yale	0FW	19-Apr-98	2
1998	182241	Fraser R. Yale	0FW	16-May-98	1
1998	182241	Fraser R. Yale	0FW	17-May-98	1
1999	183350	Fraser R. Yale	0FW	15-Apr-99	1
1999	183350	Fraser R. Yale	0FW	15-May-99	2
1999	183350	Fraser R. Yale	0FW	2-Jul-99	1
2000	183350	Fraser R. Yale	0FW	26-Mar-00	1
Spius Creek					
1996	181226	Sawmill Creek	0FW	26-Aug-96	1
1997	181226	Cheam landing Station	0FW	19-Apr-97	1
1999	182734	Fraser River, Yale	0FW	27-Jun-99	1
2000	183352	Fraser River, Yale	0FW	15-Apr-00	1
2000	181226	Fraser River, Yale	0FW	16-Apr-00	1

Appendix 1D. Observed commercial and test fishery CWT recoveries of Coldwater and Birkenhead river origin chinook by location from 1986 to 1999.

Year	Recovery Month	Week	Tag Code	Catch Region	Statistical Area
Coldwater					
1990	5	1	024607	Albion Test Fishery	29
1986	8	3	022817	Central Coast Net, Canada	8
Birkenhead					
1986	8	1	023235	Central Coast Net, Canada	8
1987	8	3	023713	Georgia Strait Net, Canada	16
1988	7	2	023234	Northwest Troll, Alaska	Unk
1988	7	3	023234	Northeast Troll, Alaska	Unk
1988	10	2	023235	Northeast Troll, Alaska	110
1989	1	4	023234	Northwest Troll, Alaska	113
1989	7	2	023234	Northeast Troll, Alaska	109
1989	7	1	023318	Northern Troll, Canada	6
1989	7	2	023713	Northeast Troll, Alaska	109
1989	7	3	023713	Northern Troll, Canada	2W
1990	6	3	024321	A111G, Alaska	111
1990	7	1	024321	Southwest Troll, Alaska	103
1991	7	1	023713	Northeast Troll, Alaska	109
1991	10	4	024321	Northwest Troll, Alaska	113
1991	4	2	024321	Albion Test Fishery	29
1991	10	5	024725	Northwest Troll, Alaska	113
1991	11	2	025408	Northwest Troll, Alaska	114
1991	11	2	025408	Northwest Troll, Alaska	114
1991	11	2	025408	Northwest Troll, Alaska	114
1991	10	2	025408	Northeast Troll, Alaska	112
1992	2	1	025408	Northwest Troll, Alaska	113
1992	11	1	025408	Northwest Troll, Alaska	113
1992	7	2	025408	Northwest Troll, Alaska	Unk
1993	12	2	020735	Northwest Troll, Alaska	113
1993	12	2	020735	Northwest Troll, Alaska	113
1993	11	4	020735	Northwest Troll, Alaska	113
1993	11	4	020735	Northwest Troll, Alaska	113
1993	8	2	020734	Area 2G, Alaska	223
1993	7	2	020734	Northwest Troll, Alaska	113
1993	11	4	020734	Northwest Troll, Alaska	113
1993	10	5	020734	Northwest Troll, Alaska	113
1993	10	5	020734	Northwest Troll, Alaska	113
1994	9	3	020735	Northwest Troll, Alaska	189
1994	9	1	020734	Northwest Troll, Alaska	113
1994	9	1	020734	Northwest Troll, Alaska	113
1994	12	1	021463	Northwest Troll, Alaska	113
1994	11	2	021463	Northwest Troll, Alaska	113
1994	7	1	021463	Northern Troll, Canada	03
1996	11	1	180738	Northwest Troll, Alaska	113
1996	11	1	180738	Northwest Troll, Alaska	113
1996	10	5	180738	Northwest Troll, Alaska	113
1997	7	2	180738	Northwest Troll, Alaska	113
1999	8	1	181514	Area 4S, Alaska	262
1999	7	1	181514	Area 4S, Alaska	Unk.
1999	12	1	181514	Northwest Troll, Alaska	113
1999	11	4	181514	Northwest Troll, Alaska	113
1999	11	3	181514	Northwest Troll, Alaska	113
1999	10	5	181514	Northwest Troll, Alaska	113
1999	10	5	181514	Northwest Troll, Alaska	113
1999	10	5	181514	Northwest Troll, Alaska	113
2000	8	2	181514	Northwest Troll, Alaska	Unk
2000	8	4	181514	Northwest Troll, Alaska	Unk
2000	9	1	181514	Northwest Troll, Alaska	Unk
2000	9	1	181514	Northwest Troll, Alaska	113
2000	9	3	181514	Northwest Troll, Alaska	113
2000	10	4	181514	Northwest Troll, Alaska	113
2000	10	4	181514	Northwest Troll, Alaska	113
2000	10	5	181514	Northwest Troll, Alaska	113

Unk indicates the statistical area was blank in the MRP database.

Appendix 2. Chinook salmon baselines by population and regional groupings used for mixed-population analysis.

Baseline	Number of populations	Populations
Fraser	48	*Upper Fraser (UPFR)*:Bowron, Dome, Fontoniko, Goat, Holmes, Horsey, Indianpoint, MacGregor, Nechako, Salmon-PG, Slim, Stuart, Swift, Tete Jeune, Willow *Mid-upper Fraser (MUFR)*:Birkenhead, Blackwater, Bridge, Chilcotin, Chilko, Cottonwood, Elkin, Endako, Horsefly, Lower Chilcotin, Portage, Quesnel, Taseko, Upper Chilcotin *North Thompson (NOTH)*:Clearwater, Finn, Louis, Mahood, Raft *South Thompson (SOTH)*:Eagle, Lower Shuswap, Little River, Lower Adams, Middle Shuswap, Salmon-SA, South Thompson *Lower Thompson (LWTH)*:Bonaparte, Coldwater, Deadman, Nicola, Spius *Lower Fraser (LWFR)*:Harrison, White Chilliwack
Southern	108	All of the above plus *Northern Mainland (NOMN)*:Atnarko,Chuckwalla, Kilbella, Kidala, Kitimat, Nusatsum, Saloompt, Upper Atnarko *Southern Mainland (SOMN)*:Bute, Devereux, Klinakini, Squamish, Wannock *Western Vancouver Island (WCVI)*:Conuma, Kennedy, Marble, Nahmint, Nitinat, Robertson, Sarita, Stamp River, Thornton, Tranquille *Eastern Vancouver Island (ECVI)*:Big Qualicum, Chemainus, Cowichan, Little Qualicum, Nanaimo(Fall), Nanaimo(Summer), Nimpkish, Puntledge(Fall), Puntledge(Summer), Quatse, Quinsam *Puget Sound* :Green, Nooksack, Samish, Skagit, Skykomish, Stillaguamish, White *Juan de Fuca* :Elwha *Coastal Washington*: Hoh, Queets, Quinault, Solduc *Lower Columbia* :Abernathy, Coweeman *Mid-Upper Columbia* :Chewack, Chiwawa, Naches, Silmilkameen, Twisp Wenatchee *Snake*: Lyon's Ferry, Snake, Tucannon *Oregon* :Trask(Spring), Trask(Fall), North Santiam

9.1 Coldwater River

Escapements of chinook salmon to the Coldwater River have been estimated since the early 1940's. Documentation of inspection dates, enumeration methods, and actual numbers of fish observed has been inconsistent, incomplete, and in some instances, non-existent. The intensity of effort expended to estimate escapements, and the reliability of the estimates are extremely variable, and the escapement estimation methods were frequently not recorded.

The existence of two timing components within the watershed further compounds the difficulty in estimating escapements for populations of the Nicola / Coldwater / Spius drainage. Tributary estimates prior to 1984 did not differentiate between the early and late components, however since then, both components have usually been estimated annually.

Chinook escapements to the Coldwater River (Appendix 3B; Figure 3.1a) during the 1970's and early 1980's were based on spot checks throughout the season. The actual numbers of fish observed were not recorded. Consequently, escapement estimates are likely unreliable. All estimates from 1970 to 1982 were recorded in the BC-16s as ranges. Escapement estimates varied from 100-300 fish (1972, 1974, 1979, and 1981) to 1000-2000 fish (1975) (Appendix Table 3B). Estimates did not differentiate between timing components, thus the estimates are of limited value.

Broodstock collection activities by Spius Creek Hatchery, starting in 1984, provided a basis for more consistent annual escapement estimates. Neither observed counts nor tallies of fish removed for broodstock were recorded in 1984 or 1985, and no escapement estimates were recorded. Streamwalks and broodstock collections during 1986 resulted in an early component escapement estimate of 450 – 500 chinook. Broodstock numbers were not reported, but a streamwalk count of 1,356 chinook was noted (probably included late component fish). How the early and late component escapement estimates were calculated was undocumented. During field operations in 1987, 233 fish were observed, and the estimate was similar to the previous year (400 – 500 fish). Based on broodstock collections and fish observed for 1988 through 1992, escapement estimates ranged from 220 (1988) to 1332 (1992).

Beginning in 1993, regular streamwalks conducted by Nicola Watershed Stewardship Fisheries Authority (NWSFA), in combination with continuing broodstock collections by Spius Creek Hatchery and observations from DFO Fishery Officers, provided raw chinook counts. As in previous years, the escapement estimation methods were usually not reported. For cases where documentation exists, escapement was estimated by reporting live fish and carcasses observed, and adding a multiple of an empty redd count (where one redd was associated with one spawning pair).

Observations recorded from 1993 and 1995 resulted in three separate escapement estimates for the early component, one from each group working on the system. For 1993, escapement estimates were 762, 800, and 1,500, while for 1995 estimates were 304, 700, and 1050. Escapement for 1994 was estimated at 275 and 300 – 500 chinook from DFO and Spius Creek Hatchery, respectively. The escapement estimate for 1996 (2,358) was extrapolated from NWSFA streamwalk data; however a large influx of late component fish was reported for the survey period, making identification of the early component extremely difficult. The early component for 1997 was estimated at 735 fish, while for 1998, NWSFA estimated escapement at 166 fish, and an estimate of 300 was entered into the BC16 database.

Aerial enumeration by the DFO Stock Assessment Division began in August 1999. Overflights and continued streamwalks by NWSFA yielded two escapement estimates for the early component. The streamwalk data are unclear, due to the probability of overlap with the late component; however escapement was estimated at less than 200 fish. Two aerial counts resulted in estimates for both the early and late components, with the former estimated at 267 fish. Preliminary aerial surveys from 2000 indicate an increased escapement over the previous two years to a level similar to 1997 (715). A maximum of 1,000 chinook was estimated from streamwalk data.

Despite the quality of the estimates in previous years, it is likely that escapements to Coldwater River have declined over the past few years. Of particular concern are the 1998 and 1999 estimates, although the escapements appear to have rebounded in 2000. We currently do not have any basis upon which to determine biologically based escapement goals, however, given the size of the system (90 km), and the apparently significant amount of available spawning habitat, escapements of 100-300 fish (<4 fish/km) seem inadequate.

9.2 Spius Creek

Escapement estimation of the early component population in Spius Creek has a similar history to the Coldwater River. Escapement estimates for Spius Creek are summarised in Appendix 3C and Figure 3.1a. During the 1970s, escapement estimates ranged from 50 (1979) to 850 (1975). As with Coldwater River, early estimates were based on undocumented field data and the calculation methods were unknown, limiting the utility of the estimates. Through the early 1970's (1970 – 1975), the timing of the run as reported in the BC16s, indicates that escapement estimates represent the early component.

Personnel shortages within DFO in the early 1980's resulted in infrequent field assessments. Escapement estimates ranged from 100 – 300 fish for this period, with the exception of 1983 (50 – 100 fish). Broodstock collections by the Spius Creek Hatchery beginning in 1986 increased the frequency and intensity of observations. Estimates from 1986 through 1992 ranged from less than 100 (1990) to a maximum of 530 – 600 (1989). Continued broodstock collections, and the introduction of an aerial enumeration program by the DFO Stock Assessment Division (1999) produced more reliable, consistent escapement estimates. Despite these efforts, gaps exist in recent enumeration and estimate documentation. The 1993 return was estimated at 365 and 900 fish by Spius Creek Hatchery and DFO Fishery Officers, respectively, although no actual numbers of fish observed were reported by either. Broodstock collections during 1994 indicated very low escapement, subsequently confirmed by an extensive streamwalk survey. The escapement estimates for 1995, 1996, and 1998 were 300 – 500, 500, and 300 chinook, respectively. No information is available for 1997. Spius Creek Hatchery provided an escapement estimate of 300 fish based on observations during broodstock collections in 1998. Two aerial surveys and observations by hatchery personnel during 1999 estimated escapement at 109 chinook. The estimate was based on an expansion of the peak live count, including hatchery broodstock collections. Similarly, in 2000, aerial surveys and streamwalks provided preliminary escapement estimates of 432 and 200 fish, respectively,.

Despite the quality of the estimates in previous years, it is likely that escapements to Spius Creek have declined over the past few years. Of particular concern are the 1998 and 1999 estimates, although the escapements appear to have rebounded in 2000. As for the Coldwater River, we currently do not have any basis upon which to determine biologically based escapement goals.

However, given its size (50 km), and the apparently significant amount of available spawning habitat, especially in Maka Creek, escapements of 100-300 fish (<6 fish/km) seem inadequate.

9.3 Upper Chilcotin River

Chinook escapement estimates for the upper Chilcotin River population (Appendix 3C; Figure 3.1b) have, in the past, been included in estimates for the lower Chilcotin River population. Inspections prior to 1994 were sporadic, and no inspections were undertaken from 1977 to 1985, due to personnel and budget limitations. Aerial surveys and spot-checks in 1987 and 1988 produced escapement estimates of 500 and 400 fish, respectively, although the data upon which these figures were based is undocumented. Since 1994, aerial surveys have provided more reliable escapement estimates specific to the upper reaches of the river (i.e. above Chilcotin Lake). Estimates ranged from a low of 262 (1995) to a maximum of 735 (1996). A preliminary escapement estimate of 201 has been calculated from aerial counts conducted during 2000.

Improvements in escapement survey frequency since 1994 have yielded estimates in which we have some confidence. Low estimates such as those in 1995 and 2000 are likely cause for concern. As for Spius and Coldwater, we have no biologically based escapement goals for this system, however, given its size (100 km) and the quality of the habitat, escapements of under 400 fish (<4 fish/km) seem inadequate.

9.4 Birkenhead River

Streamwalk surveys of the Birkenhead River have been conducted annually since 1991 (Appendix 3E; Figure 3.1b) by Hugh Naylor, Pemberton Fish and Game Club. Data available include visual counts and broodstock collections. Escapement estimates calculated from these data range from a low of 147 fish (1999), to a maximum of 713 (1992). Observations from one aerial survey and a streamwalk survey estimated escapements of 189 and 404, respectively, for 2000. Estimates for this system should be treated cautiously, as they are based on single event enumeration, i.e. one walk per season.

Of the four systems, we have most confidence in the time series of escapement data for Birkenhead, given that it has been collected in a very consistent manner since 1991. There is no apparent trend in the Birkenhead data, although as for the other streams, years of low escapements (e.g. 1995 and 1999; <3 fish/km) may be cause for concern given its size (60 km).

Appendix 3B. Estimated chinook escapements to the Coldwater River and a subjective evaluation of the utility of the estimate for time series analysis, 1970 to 2000.

Year	Dates Inspected	Escapement Estimate	Raw count observed	Methodology	Source	Estimate Useful
1970	Throughout season	500 - 1000	Not recorded	Spotchecks	BC16	No
1971	Throughout season	300 - 500 (350)	Not recorded	Spotchecks	BC16	No
1972	Throughout season	100 - 300 (100)	Not recorded	Spotchecks	BC16	No
1973	Throughout season	500 - 1000 (1000)	Not recorded	Spotchecks	BC16	No
1974	Throughout season	100 - 300 (300)	Not recorded	Spotchecks	BC16	No
1975	Throughout season	1000 - 2000 (1500)	Not recorded	Spotchecks	BC16	No
1976	Throughout season	300 - 500 (400)	Not recorded	Spotchecks	BC16	No
1977	Regularly	500 - 1000 (600)	Not recorded	Spotchecks	BC16	No
1978	Regularly	500 - 1000 (750)	Not recorded	Spotchecks	BC16	No
1979	Throughout season	100 - 300 (300)	Not recorded	Spotchecks	BC16	No
1980	Periodically	500 - 1000	Not recorded	Spotchecks	BC16	No
1981	Infrequently	100 - 300 (200)	Not recorded	Spotchecks	BC16	No
1982	Regularly through summer, occasionally in fall	500 - 1000 (800)	Not recorded	Spotchecks	BC16	No
1983	Occasionally	300	Not recorded	Not recorded	C.I.T.C.	No
1984	July 17-Oct. 13 (6)	Early – Unknown Summer - 350	Not recorded	Aerial / Walks	BC16	No
1985	Sept. 9-21 (2)	Early – Unknown Summer - 1500	Not recorded	Aerial / Walks	BC16	No
1986	Jun. 18-Aug. 13 Aug. 1-20 / Sep. 6	Early – 450 Summer - 1650	1356	Aerial / Walks	BC16	Yes
1987	June 12-Aug. 14 (15)	Early - 400 – 500 Summer - 100	233	Walks	Spius Cr. Hatchery	Yes
1988	Jun. 24-Jul. 28 Aug. (16)	Early - 220	Not recorded/59 (broodstock)	Walks/Broodstock capture	Spius Cr. Hatchery	Yes
1989	Jun. 17-Aug. 3	Early - 1050	Not recorded/151 (broodstock)	Aerial / Walks	Spius Cr. Hatchery	Yes
1990	Jul. 4-Aug. 16	Early - 350/<300	Not recorded/61 (broodstock)	Walks/Broodstock capture	Spius Cr. Hatchery	Yes
1991	Jul. 19-Aug. 14	Early - 325	Not recorded/74 (broodstock)	Walks/Broodstock capture	Spius Cr. Hatchery	Yes
1992	Jun. 11-Aug. 10	Early - 1332	Not recorded/102 (broodstock)	Walks/Broodstock capture	Spius Cr. Hatchery	Yes
1993	Jul. 13-Aug. 7/Aug. 23-26/ Sept. 13	Early - 762, 800, 1500	456, 95 (broodstock)	Walks Broodstock capture	NWSFA/Spius	Yes
1994	Jul. 28-Aug. 16	Early - 275/300 - 500	Not recorded	Walks Broodstock capture	NWSFA/Spius	Yes

Year	Dates Inspected	Escapement Estimate	Raw count observed	Methodology	Source	Estimate Useful
1995	Jul. 25-29 August 15,27,28,29, Oct. 6	Early - 304/700/1050	680	Walks Broodstock capture	NWSFA/Spius	Yes
1996	Jul. 24-Aug. 6/Aug. 19-21 Aug. 27-29	2358	1530	Walks Broodstock capture	NWSFA/Spius	No
1997	Jul. 23-Aug. 27/Aug. 27-29	Early - 735	221	Streamwalks	NWSFA/Spius	Yes
1998	Aug. 20-22/26-28/Sep. 1	Early - 166 - 300	80	Streamwalks	NWSFA/Spius	Yes
1999	Aug. 18/23-25/26/Aug. 31-Sep. 3 Sep. 5,9,12,15,19	Early - <200 – 267 Summer - 237	Early – 135 Summer - 154	Streamwalks/Aerial	NWSFA/Spius	Yes
2000	Aug. 18-21/23-25/28-30 Aug. 18,23,30	1000/715 (Preliminary)	1150/1113	Streamwalks/Aerial	NWSFA/DFO - StAD	Yes

Appendix 3C. Estimate chinook escapement to Spius Creek and a subjective evaluation of the utility of the estimate for time series analysis, 1970 to 2000.

Year	Dates Inspected	Escapement estimate	Raw count observed	Methodology	Source	Estimate Useful
1970	Throughout season	500 - 1000 (750)	Not recorded	Spotchecks	BC16	Yes
1971	Throughout season	300 - 500 (500)	Not recorded	Spotchecks	BC16	Yes
1972	Throughout season	300 - 500 (400)	Not recorded	Spotchecks	BC16	Yes
1973	Throughout season	500 - 1000 (500)	Not recorded	Spotchecks	BC16	Yes
1974	Throughout season	500 - 1000 (500)	Not recorded	Spotchecks	BC16	Yes
1975	Not recorded	500 - 1000 (850)	Not recorded	Spotchecks	BC16	Yes
1976	Throughout season	100 - 300 (200)	Not recorded	Spotchecks	BC16	No
1977	Throughout season	100 - 300 (150)	Not recorded	Spotchecks	BC16	No
1978	Jul. 27, Aug. 25, Sep. 6, 8, 18	50 - 100 (80)	Not recorded	Spotchecks	BC16	No
1979	Sept. 19	1 - 50 (50)	Not recorded	Spotchecks	BC16	No
1980	Not recorded	100 - 300	Not recorded	Aerial	BC16	No
1981	Infrequently	100 - 300 (100)	Not recorded	Not recorded	BC16	No
1982	Infrequently	100 - 300 (200)	Not recorded	Not recorded	BC16	No
1983	Infrequently	50 - 100	55	Not recorded	C.I.T.C.	No
1984	Not recorded	210	Not recorded	Not recorded	C.I.T.C.	No
1985	Jul. 15 - Dec. 10	No estimate	Not recorded	Aerial/Streamwalk	BC16	No
1986	Jun. 17 - Aug. 15, Sep.	350 - 500	138 (broodstock)	Broodstock capture	Spius Cr. Hatchery	Yes
1987	May 27- Aug. 11	350 - 500	113 (broodstock)	Broodstock capture	Spius Cr. Hatchery	Yes
1988	Jun. 23- Aug. 11	120	29 (broodstock)	Broodstock capture	Spius Cr. Hatchery	Yes
1989	Jun. 9 - Aug. 10	530 - 600	140 (broodstock)	Broodstock capture	Spius Cr. Hatchery	Yes
1990	Jun. 15 - Jul. 30	<100	Not recorded/no brood	Broodstock capture	Spius Cr. Hatchery	Yes
1991	Jun. 17 - Jul. 29	248	78 (broodstock)	Broodstock capture	Spius Cr. Hatchery	Yes
1992	Jun. 1 - Aug. 6	250	73 (broodstock)	Broodstock capture	Spius Cr. Hatchery	Yes
1993	Jun. 4 - Aug. 21/Sep. 13	365/900	Not recorded	Aerial/Broodstock capture	Spius Cr. Hatchery	Yes
1994	Jun. 27 - Aug. 20	120/150/162	Not recorded	Walk/Broodstock capture	Spius Cr. Hatchery	Yes
1995	Jun. 22 - Jul. 22	310/500	308	Broodstock capture	Spius Cr. Hatchery	Yes
1996	Jun. 19 - Aug. 7	500	Not recorded	Broodstock capture	Spius Cr. Hatchery	Yes
1997	Jun. 14 - Jul. 25	No estimate	Not recorded	Broodstock capture	Spius Cr. Hatchery	No
1998	Not recorded	300	Not recorded	Broodstock capture	Spius Cr. Hatchery	Yes
1999	Aug. 18, 26, Sep. 5, 9, 2, 15, 19	109	34/57 (broodstock)	Aerial/Broodstock capture	Spius Cr. Hatchery	Yes
2000	Aug. 18, 23, 30	200/432 (Preliminary)	810	Streamwalk/Aerial	NWSFA/DFO - StAD	Yes

Appendix 3D. Estimated chinook escapement to the upper Chilcotin River and a subjective evaluation of the utility of the estimate for time series analysis, 1970 to 2000.

Year	Dates inspected	Escapement Estimate	Raw Count Observed	Methodology	Source	Estimate useful
1970	August. 21	Included in Lower		Spotchecks	BC16	No
1971	Sept. 4, 9	Included in Lower		Spotchecks	BC16	No
1972	Aug. 26, Sept. 15	0	0	Spotchecks	BC16	No
1973	Aug. 2, 9, 13	Included in Lower		Spotchecks	BC16	No
1974	Not inspected					No
1975	Not inspected					No
1976	Aug. 18, Sept. 3	Incl. In Lower		Spotchecks	BC16	No
1977	Not inspected					No
1978	Not inspected					No
1979	Not inspected			Aerial		No
1980	Not inspected					No
1981	Not inspected					No
1982	Not inspected					No
1983	Not inspected					No
1984	Not inspected					No
1985	Not inspected					No
1986	Aug. 27, 30	Included in Lower	300	Aerial / Spotchecks	BC16	No
1987	Aug. 20, Sept. 2	500	Not recorded	Aerial / Spotchecks	BC16	Yes
1988	Aug. 20, Sept. 2	400	Not recorded	Aerial	BC16	Yes
1989	Not inspected					No
1990	Not inspected					No
1991	Not inspected					No
1992	Not inspected					No
1993	No Records					No
1994	Sept. 2	450	Not recorded	Aerial	BC16	Yes
1995	Aug. 24,30	262	Not recorded	Aerial	BC16	Yes
1996	Aug. 14, 27	735	484	Aerial	BC16	Yes
1997	Aug. 13, 18, 26	360	233	Aerial	BC16	Yes
1998	Aug. 07, 14, 21	618	383	Aerial	BC16	Yes
1999	Aug. 10, 17, 23, 30	285	185	Aerial	BC16	Yes
2000	Aug. 11, 16, 20, 24	201(Preliminary)	104	Aerial	DFO - StAD	Yes

Appendix 3E. Estimated chinook escapement to the Birkenhead River and a subjective evaluation of the utility of the estimate for time series analysis, 1991 to 2000.

Year	Dates Inspected	Escapement Estimate	Raw Count Observed	Methodology	Source	Estimate Useful
1991	Sep. 12 +/- 1 day	242	144	Streamwalk	H. Naylor	Yes
1992	Sep. 12 +/- 1 day	713	446	Streamwalk	H. Naylor	Yes
1993	Sep. 12 +/- 1 day	241	138	Streamwalk	H. Naylor	Yes
1994	Sep. 12 +/- 1 day	343	205	Streamwalk	H. Naylor	Yes
1995	Sep. 12 +/- 1 day	162	91	Streamwalk	H. Naylor	Yes
1996	Sep. 12 +/- 1 day	293	171	Streamwalk	H. Naylor	Yes
1997	Sep. 12 +/- 1 day	573	353	Streamwalk	H. Naylor	Yes
1998	Sep. 12 +/- 1 day	565	348	Streamwalk	H. Naylor	Yes
1999	Sep. 12 +/- 1 day	147	81	Streamwalk	H. Naylor	Yes
2000	Sep. 6/Sep. 12 +/- 1 day	189/404	123/242	Aerial/Streamwalk	DFO – StAD/H. Naylor	Yes

Appendix 4. Estimated percentage stock compositions of chinook salmon from the Albion test fishery, 1995.

	April 14-30 n = 44 (44)		May 1-31 n = 94 (94)	
	Percentage	SD	Percentage	SD
Harrison	1.8	(2.4)	0.0	(0.0)
Birkenhead	2.3	(2.0)	0.0	(0.0)
W_Chilliwack	0.0	(0.2)	0.0	(0.0)
Stave	0.0	(0.6)	0.0	(0.0)
Bonaparte	0.0	(0.5)	2.5	(1.7)
Coldwater	3.7	(3.2)	0.0	(0.8)
Deadman	0.0	(0.7)	0.0	(0.4)
Nicola	1.5	(2.1)	0.0	(0.9)
Spius	0.0	(2.7)	0.0	(0.4)
Blackwater	0.0	(1.6)	3.2	(1.9)
Bridge	11.1	(8.0)	1.5	(3.6)
Chilcotin	8.7	(6.3)	0.0	(0.6)
Chilko	0.0	(2.2)	0.0	(1.4)
Cottonwood	0.0	(1.8)	4.6	(2.4)
Elkin	0.0	(1.0)	0.0	(1.9)
Endako	1.9	(2.6)	6.4	(3.0)
Horsefly	0.0	(0.9)	0.0	(0.4)
L.Chilcotin	18.6	(6.4)	4.6	(2.6)
Portage	0.0	(0.0)	0.0	(0.0)
Quesnel	3.1	(5.5)	0.8	(4.4)
Taseko	0.0	(1.5)	1.6	(1.8)
U. Chilcot	10.7	(5.0)	6.2	(2.3)
Clearwater (Thom)	0.0	(0.9)	0.0	(0.2)
Finn	0.0	(0.0)	0.0	(0.2)
Louis	0.0	(0.0)	1.0	(0.8)
Mahood	0.0	(0.0)	1.0	(0.2)
Raft	3.6	(4.3)	0.0	(0.0)
Eagle	0.0	(0.0)	0.0	(0.0)
L Shuswap	0.0	(0.0)	1.1	(0.9)
U_AdamsTransp	0.0	(0.0)	0.0	(0.0)
Little R	0.0	(0.6)	0.0	(0.0)
Lower Adams	0.0	(0.6)	0.0	(0.0)
M Shuswap	0.0	(0.0)	0.0	(0.0)
Salmon@SA	0.0	(0.0)	0.0	(0.0)
South Thom	0.0	(0.0)	0.0	(0.0)
Bowron	0.0	(3.0)	2.9	(4.6)
Dome	0.0	(1.8)	4.8	(4.6)
TeteJeune	2.4	(3.9)	2.9	(2.5)
Willow	0.0	(1.1)	7.7	(3.9)
Fontoniko	0.0	(0.1)	0.0	(0.1)
Goat	0.0	(0.5)	0.3	(1.0)
Holmes	9.8	(5.2)	2.8	(3.7)
Horsey	0.0	(0.0)	0.0	(0.2)
Indianpoint	0.0	(1.1)	1.2	(1.5)
MacGregor	0.0	(1.1)	14.3	(5.0)
Nechako	10.6	(8.1)	12.2	(5.9)
Salmon@PG	10.3	(6.0)	3.8	(3.8)
Slim	0.0	(2.0)	2.7	(2.7)
Stuart	0.0	(7.2)	10.0	(4.4)
Swift	0.0	(1.7)	0.0	(0.6)
UPFR	33.1	(9.5)	65.5	(8.3)
MUFR	54.0	(10.5)	29.0	(8.1)
LWFR	1.8	(2.4)	0.0	(0.0)
NOTH	3.6	(4.4)	2.0	(0.9)
SOTH	0.0	(0.8)	1.1	(0.9)
LWTH	5.2	(3.5)	2.5	(1.7)
Birk	2.3	(2.0)	0.0	(0.0)
Cold/Spius/Nicola	5.2	(3.5)	0.0	(1.3)
Up./Lower Chilcotin	38.0	(8.8)	10.9	(3.0)

Appendix 5. Estimated percentage stock compositions of chinook salmon from the WCVI troll fishery in southern (SWVI) and northern (NWVI) areas for target stocks. Stock compositions were estimated with a 108-population southern baseline. Standard deviation is in parentheses and was estimated from 100 bootstrap resamplings of both the baseline and mixtures.

	SWVI Troll				NWVI Troll				
	Apr-May-98	Apr-May-00	Oct-Nov-98	Oct-Nov-99	Apr-May-98	Apr-00	May-00	Oct-Nov-98	Oct-Nov-99
N	112	180	65	203	125	104	376	126	200
UPFR	0.7 (1.6)	2.2 (1.8)	3.9 (3.3)	0.0 (0.9)	0.0 (1.3)	0.9 (1.5)	11.7 (2.3)	4.5 (2.1)	0.0 (1.0)
MUFR	2.5 (1.8)	1.5 (1.0)	6.4 (4.6)	0.0 (0.4)	0.8 (1.6)	2.1 (2.1)	6.6 (1.8)	0.0 (0.5)	0.3 (0.3)
LWFR	0.0 (2.4)	10.6 (2.8)	0.0 (2.0)	23.1 (3.5)	9.2 (3.5)	19.2 (5.0)	27.3 (2.5)	5.8 (3.3)	26.9 (4.4)
NOTH	0.0 (0.6)	0.0 (0.6)	0.0 (2.1)	0.0 (0.5)	0.0 (1.6)	1.4 (1.5)	3.1 (1.1)	0.2 (1.1)	0.0 (0.1)
SOTH	0.7 (1.6)	3.3 (1.9)	0.0 (1.9)	0.0 (0.7)	3.9 (2.1)	3.3 (1.7)	0.8 (0.7)	0.0 (0.8)	0.0 (0.6)
LWTH	0.0 (1.2)	1.7 (0.8)	0.0 (2.4)	0.0 (0.0)	0.0 (0.7)	1.1 (1.3)	0.6 (0.4)	0.0 (0.3)	0.0 (0.3)
ECVI	1.7 (4.8)	3.3 (3.4)	16.6 (6.9)	5.9 (3.2)	5.7 (3.8)	2.8 (4.0)	3.7 (1.3)	5.3 (3.9)	9.3 (3.8)
WCVI	2.3 (1.8)	1.2 (1.1)	1.1 (3.7)	0.0 (0.4)	1.1 (1.9)	2.3 (1.8)	0.3 (0.5)	1.4 (1.6)	0.0 (0.7)
SOMN	3.0 (2.8)	3.9 (2.0)	12.1 (7.6)	2.5 (1.3)	2.4 (3.6)	6.8 (2.9)	0.7 (0.8)	1.1 (2.0)	1.3 (1.1)
NOMN	1.8 (3.6)	1.3 (2.0)	3.9 (4.8)	3.8 (2.0)	4.7 (3.2)	0.0 (2.7)	13.6 (2.3)	2.6 (2.3)	0.0 (1.1)
Puget Sound	59.8 (6.3)	38.9 (4.4)	25.7 (11.4)	44.6 (4.3)	46.8 (6.3)	31.3 (6.0)	7.6 (1.7)	71.5 (6.6)	47.1 (4.9)
Juan de Fuca	0.0 (0.8)	0.6 (0.6)	0.0 (3.4)	1.1 (1.0)	0.0 (1.4)	0.0 (0.9)	0.0 (0.5)	0.0 (1.0)	0.2 (0.5)
Coastal Wash	2.2 (2.4)	2.4 (1.7)	11.6 (7.5)	3.6 (1.8)	3.6 (1.8)	1.2 (1.4)	1.1 (1.0)	0.0 (0.8)	0.8 (1.0)
Lower Columb	18.6 (4.6)	11.8 (2.3)	14.7 (6.8)	10.3 (2.6)	7.9 (2.9)	2.4 (1.3)	3.7 (1.2)	5.5 (2.5)	6.7 (1.9)
Mid/Up Colum	3.6 (2.9)	7.5 (3.1)	4.1 (5.2)	3.8 (1.6)	9.2 (3.8)	12.9 (3.9)	10.6 (1.8)	0.0 (1.4)	1.7 (1.7)
Snake	0.0 (1.9)	7.1 (2.4)	0.0 (3.8)	1.3 (1.0)	2.2 (2.2)	8.3 (3.2)	4.2 (1.1)	1.2 (1.8)	5.7 (1.9)
Oregon	3.2 (1.9)	2.7 (1.2)	0.0 (4.2)	0.0 (0.6)	2.8 (2.0)	4.1 (1.8)	4.6 (1.2)	0.9 (1.2)	0.0 (0.1)
Σ Vancouver Isl.	4.0 (5.2)	4.5 (3.6)	17.8 (8.1)	5.9 (3.2)	6.7 (3.9)	5.1 (4.4)	3.9 (1.4)	6.7 (4.0)	9.3 (3.9)
Σ Fraser	3.8 (4.1)	19.2 (3.7)	10.2 (6.5)	23.1 (3.6)	13.8 (4.0)	28.0 (5.7)	50.0 (2.9)	10.5 (4.1)	27.2 (3.6)
Σ Mainland coast	4.8 (4.1)	5.2 (2.7)	15.9 (9.1)	6.2 (2.5)	7.0 (4.3)	6.8 (3.6)	14.3 (2.3)	3.7 (2.9)	1.4 (1.6)
Σ Columbia	22.2 (5.8)	26.5 (4.0)	18.8 (8.9)	15.4 (2.8)	19.3 (5.1)	23.5 (4.1)	18.6 (2.1)	6.7 (3.1)	14.1 (2.9)
Σ non-Columbia US	65.2 (6.5)	44.6 (4.8)	37.3 (12.8)	49.4 (4.2)	53.2 (6.1)	36.7 (6.0)	13.2 (2.3)	72.4 (6.6)	48.1 (4.8)
Σ Canadian	12.7 (6.2)	28.9 (4.8)	43.9 (12.7)	35.3 (4.9)	27.8 (6.6)	39.8 (5.9)	68.2 (2.7)	20.9 (6.1)	37.9 (4.6)
Σ U.S.	87.4 (6.2)	71.1 (4.8)	56.1 (12.7)	64.7 (4.9)	72.2 (6.6)	60.2 (5.9)	31.8 (2.7)	79.1 (6.1)	62.1 (4.9)
Σ Other	97.5 (1.6)	100.0 (0.4)	98.9 (4.3)	100.0 (0.0)	100.0 (1.1)	99.4 (1.2)	98.7 (0.7)	100.0 (0.3)	100.0 (0.0)
Birkenhead	0.0 (0.0)	0.0 (0.0)	0.0 (2.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Cold/Nicola/Spius	0.0 (0.0)	0.0 (0.4)	0.0 (1.6)	0.0 (0.0)	0.0 (0.6)	0.0 (0.8)	0.0 (0.0)	0.0 (0.2)	0.0 (0.0)
Low./Upper Chilcotin	2.5 (1.6)	0.0 (0.0)	1.1 (3.4)	0.0 (0.0)	0.0 (1.0)	0.6 (0.8)	1.3 (0.7)	0.0 (0.1)	0.0 (0.0)

Appendix 6. Estimated percentage stock compositions of chinook salmon from recreational fisheries by region and for target stocks. Stock compositions were estimated with a 108-population southern baseline. Standard deviation is in parentheses and was estimated from 100 bootstrap resamplings of both the baseline and mixtures.

	Victoria							Sechelt	Powell R.	Vancouver	Campbell R.	Nanaimo
	Nov-Dec-99	Jan-00	Feb-00	Mar-00	Apr-00	May-00	Jun-00	Apr-May-Jun-00	Apr-May-00	Apr-May-00	May-June-00	June-00
N	117	155	267	29	37	48	102	33	46	12	121	57
UPFR	0.0 (0.7)	0.0 (0.4)	0.2 (0.4)	0.0 (2.2)	0.0 (0.0)	9.8 (4.8)	51.0 (5.8)	0.0 (0.0)	0.0 (0.2)	0.0 (3.3)	2.5 (2.2)	0.0 (1.5)
MUFR	0.6 (0.9)	0.0 (0.4)	0.4 (0.5)	2.9 (3.1)	0.0 (1.2)	3.9 (3.0)	8.5 (3.4)	0.0 (0.5)	0.0 (0.0)	15.5 (9.2)	1.0 (1.3)	0.0 (0.5)
LWFR	0.0 (1.5)	0.0 (1.0)	0.8 (1.1)	0.0 (2.0)	6.5 (4.8)	2.4 (2.3)	0.9 (1.4)	12.5 (7.8)	0.0 (0.1)	0.0 (0.7)	24.9 (4.3)	58.8 (6.4)
NOTH	0.0 (0.5)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.1 (2.8)	7.6 (3.2)	2.9 (2.8)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)
SOTH	0.0 (0.3)	0.0 (0.5)	0.0 (0.2)	0.0 (1.7)	2.3 (3.7)	0.0 (1.7)	6.1 (2.3)	2.9 (2.8)	0.0 (0.0)	0.0 (0.1)	7.6 (2.6)	0.2 (1.6)
LWTH	0.0 (0.0)	0.0 (0.3)	0.0 (0.1)	0.0 (0.0)	5.2 (4.9)	8.4 (4.4)	9.9 (3.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.4 (0.8)	1.9 (1.8)
ECVI	9.7 (5.3)	2.0 (3.0)	9.3 (3.9)	1.8 (7.8)	2.1 (5.8)	0.0 (4.9)	1.1 (2.2)	41.4 (9.5)	84.4 (5.6)	15.9 (14.7)	50.8 (5.4)	14.9 (6.3)
WCVI	1.5 (1.6)	0.0 (0.7)	0.0 (0.1)	0.5 (4.2)	0.0 (1.0)	0.0 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (1.5)	0.0 (1.7)	0.8 (0.9)	0.0 (0.0)
SOMN	3.1 (2.6)	0.0 (0.8)	0.0 (0.3)	0.0 (1.1)	0.0 (1.4)	0.0 (0.2)	0.0 (0.1)	9.0 (5.1)	6.4 (3.6)	30.7 (13.7)	1.8 (1.4)	0.3 (2.5)
NOMN	1.9 (3.1)	1.5 (2.6)	0.8 (1.0)	0.0 (3.6)	0.0 (1.3)	2.1 (2.0)	0.0 (0.3)	0.9 (2.4)	0.0 (2.0)	0.0 (2.2)	0.0 (1.2)	0.0 (2.9)
Puget Sound	75.5 (6.1)	93.6 (4.6)	85.6 (4.3)	91.6 (9.3)	81.3 (8.5)	64.9 (8.9)	9.8 (3.5)	30.4 (9.9)	7.1 (4.4)	22.5 (12.0)	9.3 (2.8)	23.9 (6.8)
Juan de Fuca	0.0 (0.0)	0.0 (0.6)	0.6 (1.0)	0.0 (0.0)	0.0 (0.5)	0.0 (0.8)	3.0 (1.4)	0.0 (0.0)	2.2 (2.0)	0.0 (1.7)	0.0 (0.3)	0.0 (0.5)
Coastal Wash	0.0 (1.2)	1.3 (1.1)	1.5 (0.8)	0.0 (1.7)	0.0 (0.6)	0.0 (0.9)	0.0 (0.2)	0.0 (0.3)	0.0 (0.8)	0.0 (0.1)	0.0 (0.3)	0.0 (0.0)
Lower Columb	1.5 (1.3)	1.1 (1.0)	0.0 (0.4)	0.0 (0.0)	0.0 (1.9)	0.0 (1.2)	0.0 (0.5)	0.0 (0.4)	0.0 (0.2)	7.7 (5.2)	0.3 (0.6)	0.0 (0.0)
Mid/Up Colum	5.6 (3.1)	0.5 (0.8)	0.4 (0.8)	3.2 (3.2)	0.0 (1.8)	3.2 (2.8)	1.0 (0.8)	0.0 (0.9)	0.0 (0.0)	7.7 (6.6)	0.8 (0.6)	0.0 (0.6)
Snake	0.0 (0.9)	0.0 (0.9)	0.4 (0.4)	0.0 (1.5)	0.0 (0.4)	0.0 (1.2)	1.0 (0.5)	0.0 (0.1)	0.0 (0.0)	0.0 (1.9)	0.0 (0.6)	0.0 (0.2)
Oregon	0.7 (0.8)	0.0 (0.3)	0.0 (0.2)	0.0 (0.0)	2.6 (2.5)	2.1 (1.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.3)	0.0 (0.0)
Σ Vancouver Isl.	11.2 (5.5)	2.0 (3.1)	9.3 (3.8)	2.3 (8.0)	2.1 (5.7)	0.0 (4.9)	1.1 (2.2)	41.4 (9.5)	84.4 (5.5)	15.9 (14.5)	51.6 (5.3)	14.9 (6.3)
Σ Fraser	0.6 (1.9)	0.0 (1.3)	1.4 (1.3)	2.9 (3.9)	14.0 (6.5)	27.7 (6.3)	84.1 (3.9)	18.4 (8.3)	0.0 (0.2)	15.5 (9.4)	36.3 (5.1)	61.0 (6.7)
Σ Mainland coast	5.0 (4.0)	1.5 (2.7)	0.8 (1.0)	0.0 (3.7)	0.0 (1.9)	2.1 (2.0)	0.0 (0.3)	9.8 (5.7)	6.4 (3.8)	30.7 (13.7)	1.8 (1.7)	0.3 (3.5)
Σ Columbia	7.0 (3.4)	1.5 (1.4)	0.8 (0.9)	3.2 (3.6)	0.0 (2.6)	3.2 (3.4)	2.0 (1.1)	0.0 (1.0)	0.0 (0.2)	15.4 (9.2)	1.1 (1.0)	0.0 (0.7)
Σ non-Columbia US	76.2 (6.0)	94.9 (4.5)	87.7 (4.2)	91.6 (9.0)	84.0 (8.8)	67.0 (9.1)	12.8 (3.7)	30.4 (9.9)	9.2 (4.7)	22.5 (12.3)	9.3 (2.8)	23.9 (6.8)
ΣCanadian	16.8 (5.9)	3.6 (4.4)	11.5 (4.0)	5.1 (8.9)	16.0 (8.4)	29.8 (8.5)	85.2 (3.5)	69.6 (9.9)	90.8 (4.7)	62.1 (14.1)	89.7 (2.9)	76.1 (6.8)
Σ U.S.	83.2 (5.9)	96.4 (4.4)	88.5 (4.0)	94.9 (8.9)	84.0 (8.4)	70.2 (8.5)	14.8 (3.5)	30.4 (9.9)	9.2 (4.7)	37.9 (14.1)	10.3 (2.9)	23.9 (6.8)
Σ Other	100.0 (0.0)	100.0 (0.3)	99.6 (0.4)	100.0 (0.0)	97.9 (4.0)	93.9 (4.0)	92.6 (3.0)	100.0 (0.0)	100.0 (0.0)	100.0 (0.0)	99.6 (0.8)	98.1 (2.0)
Birkenhead	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Cold/Nicola/Spius	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	2.1 (4.0)	6.1 (3.5)	6.6 (2.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.4 (0.6)	1.9 (2.0)
L./Upper Chilcotin	0.0 (0.0)	0.0 (0.3)	0.4 (0.4)	0.0 (0.0)	0.0 (0.0)	0.0 (1.5)	0.8 (1.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.4)	0.0 (0.0)

Appendix 7. Estimated percentage stock compositions of chinook salmon from the lower Fraser First Nations fishery from 1997 to 1999. Stock compositions were estimated with a 48-population Fraser baseline. Standard deviation is in parentheses and was estimated from 100 bootstrap resamplings of both the baseline and mixtures.

	<April 19			April 24- 26			May 2- 3			May 8-10		May 15-17	
	1997	1998	1999	1997	1998	1999	1997	1998	1999	1998	1999	1998	1999
N	115	114	142	29	30	191	51	50	62	119	137	164	126
Harrison	2.3 (2.2)	0.0 (0.2)	0.0 (0.1)	0.0 (2.6)	0.0 (0.0)	0.1 (0.7)	0.8 (4.6)	0.0 (1.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.3)	0.0 (0.3)	0.0 (0.0)
Birkenhead	7.2 (2.9)	8.4 (2.5)	12.1 (2.7)	4.0 (4.2)	8.6 (5.7)	1.6 (0.8)	5.3 (3.1)	4.4 (2.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.6 (1.1)	0.0 (0.0)
W_Chilliwack	2.5 (2.3)	0.0 (0.6)	0.0 (0.7)	0.0 (3.3)	0.0 (0.0)	0.6 (0.6)	0.0 (1.1)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.0 (0.3)	0.0 (0.6)	0.0 (0.1)
Bonaparte	0.1 (3.1)	0.8 (3.3)	0.0 (0.9)	0.0 (4.0)	0.0 (0.1)	4.2 (1.8)	0.0 (2.9)	0.0 (0.0)	8.7 (5.5)	0.0 (3.4)	0.0 (2.5)	0.0 (1.6)	3.5 (2.5)
Cold/Spius/Nicola	11.1 (5.6)	24.6 (5.3)	26.0 (5.2)	9.4 (5.9)	13.5 (7.6)	13.8 (2.6)	7.3 (5.4)	16.0 (7.0)	15.6 (6.1)	15.0 (5.8)	28.4 (4.8)	13.5 (4.0)	25.1 (4.7)
Deadman	8.5 (4.9)	2.5 (3.4)	0.0 (1.4)	0.0 (2.5)	0.0 (2.8)	0.0 (0.9)	9.5 (5.1)	0.2 (2.2)	5.5 (4.5)	7.7 (4.3)	3.3 (2.8)	0.0 (1.4)	3.0 (3.0)
Blackwater	0.0 (1.3)	3.8 (3.4)	0.0 (2.9)	0.0 (0.9)	0.0 (1.8)	4.1 (1.5)	0.0 (1.7)	0.0 (3.4)	5.5 (2.6)	0.0 (0.6)	4.3 (1.9)	1.7 (1.9)	3.4 (1.5)
Bridge	0.0 (4.2)	4.0 (6.5)	2.5 (2.5)	9.6 (7.3)	0.1 (8.5)	7.4 (4.2)	5.9 (7.2)	0.0 (8.8)	2.6 (4.4)	1.7 (5.6)	6.8 (5.5)	6.3 (5.3)	1.6 (5.0)
Up./Lower Chilcot	32.3 (6.2)	30.3 (6.2)	34.8 (6.0)	18.5 (10.3)	26.2 (11.3)	13.4 (2.8)	13.9 (7.7)	9.7 (5.7)	18.1 (6.2)	10.7 (4.0)	23.3 (4.6)	19.6 (4.5)	18.6 (4.4)
Chilko	0.0 (0.3)	0.0 (0.2)	1.3 (1.2)	0.0 (2.1)	0.0 (1.1)	0.7 (0.8)	9.0 (5.6)	0.0 (2.6)	0.0 (0.4)	2.6 (3.3)	0.0 (1.3)	0.0 (0.2)	0.0 (0.8)
Cottonwood	4.4 (2.3)	3.2 (2.1)	0.0 (1.4)	20.8 (10.0)	8.2 (6.5)	9.4 (2.2)	8.9 (5.4)	20.2 (8.4)	1.4 (2.7)	10.5 (5.1)	1.9 (1.4)	17.5 (4.5)	14.9 (4.0)
Elkin	0.0 (0.0)	0.0 (0.2)	0.0 (0.2)	0.0 (2.2)	0.0 (0.0)	0.0 (0.0)	0.0 (3.1)	0.0 (0.0)	0.0 (0.3)	0.0 (0.2)	0.0 (0.3)	0.0 (0.0)	0.0 (0.1)
Endako	1.5 (2.1)	2.7 (2.4)	0.0 (0.0)	0.0 (3.3)	0.0 (5.7)	3.8 (1.5)	0.9 (4.2)	3.7 (3.9)	0.0 (1.6)	2.7 (3.0)	0.0 (1.1)	1.5 (3.2)	0.0 (0.8)
Horsefly	0.0 (1.0)	0.0 (0.2)	0.0 (0.6)	0.0 (4.6)	0.0 (1.0)	0.0 (0.2)	0.0 (1.5)	0.0 (2.0)	0.0 (0.9)	0.0 (1.4)	1.7 (0.9)	1.1 (2.4)	0.8 (1.1)
Portage	0.0 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (1.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.2 (0.4)	0.0 (0.0)
Quesnel	0.0 (3.6)	0.0 (1.8)	0.0 (0.0)	0.0 (0.9)	0.0 (0.4)	0.0 (2.5)	0.0 (1.0)	0.0 (2.7)	0.0 (3.3)	0.1 (2.3)	0.3 (1.9)	0.0 (2.1)	0.0 (1.7)
Taseko	0.0 (0.0)	0.0 (0.8)	5.6 (3.0)	0.0 (3.1)	0.0 (2.9)	0.0 (1.0)	0.0 (0.4)	0.0 (0.0)	0.0 (1.2)	0.0 (0.8)	0.0 (0.7)	0.0 (0.2)	0.0 (0.3)
Clearwa(Thom)	0.0 (0.1)	0.0 (0.4)	1.5 (1.6)	1.3 (4.5)	0.0 (5.1)	0.0 (0.3)	0.0 (3.6)	2.8 (4.6)	0.0 (0.7)	0.0 (0.2)	0.0 (0.2)	2.6 (2.2)	0.0 (1.4)
Finn	0.0 (0.3)	0.0 (0.9)	0.8 (0.6)	2.3 (3.3)	4.4 (4.1)	0.0 (0.2)	0.0 (1.2)	0.0 (0.9)	0.0 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (1.3)	0.0 (0.8)
Louis	1.7 (1.9)	0.5 (1.1)	0.0 (0.0)	0.0 (0.5)	0.0 (2.1)	2.3 (1.2)	0.0 (0.2)	6.3 (4.1)	1.8 (1.4)	0.0 (0.6)	0.1 (0.8)	1.7 (1.4)	0.9 (1.0)
Mahood	0.0 (0.2)	0.0 (0.2)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.6)	0.0 (0.7)	0.0 (0.0)	0.0 (0.2)	0.0 (0.1)
Raft	0.0 (0.5)	0.7 (1.1)	0.0 (1.6)	0.0 (1.2)	0.0 (0.0)	0.0 (1.0)	0.0 (1.0)	0.0 (3.0)	3.4 (3.5)	0.0 (1.1)	3.3 (2.4)	0.4 (1.6)	1.9 (2.5)
Eagle	0.0 (0.4)	0.0 (0.6)	0.0 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.3)	0.0 (0.9)	0.0 (0.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
L Shuswap	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.0 (0.1)	0.0 (0.0)
Little R	0.0 (0.3)	0.0 (0.0)	0.0 (0.3)	0.0 (2.4)	0.0 (1.5)	0.0 (0.0)	0.0 (0.9)	0.0 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.5)	0.0 (0.0)	0.0 (0.2)
Lower Adams	0.0 (0.5)	0.0 (0.7)	0.0 (0.9)	4.3 (3.7)	0.0 (0.0)	0.0 (0.1)	0.0 (0.8)	0.0 (2.7)	0.0 (0.0)	1.0 (1.0)	0.0 (0.7)	0.0 (0.3)	0.0 (0.0)
M Shuswap	0.0 (0.2)	0.0 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.0)	0.0 (0.5)	0.0 (0.0)
Salmon@SA	0.2 (1.2)	0.1 (0.9)	0.2 (1.0)	0.0 (0.0)	0.0 (2.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.4)	0.0 (0.1)	0.0 (0.0)	0.7 (0.8)
South Thom	0.0 (0.8)	0.0 (0.7)	0.0 (0.2)	0.0 (2.5)	0.0 (1.1)	0.0 (0.1)	0.0 (0.0)	0.0 (1.0)	0.0 (0.0)	0.0 (0.9)	0.0 (0.5)	0.0 (0.4)	0.0 (0.0)
Bowron	0.0 (2.9)	0.0 (0.3)	0.0 (3.5)	1.4 (11.0)	6.2 (9.8)	1.5 (2.4)	0.3 (6.6)	3.0 (6.0)	0.3 (2.3)	0.0 (3.4)	0.0 (1.8)	0.0 (3.6)	0.0 (1.8)
Dome	2.4 (1.7)	0.0 (0.8)	0.0 (1.4)	0.0 (3.8)	0.0 (2.2)	2.0 (1.7)	6.9 (6.6)	0.0 (3.6)	0.0 (0.0)	1.3 (5.9)	1.1 (1.7)	0.0 (2.9)	0.0 (0.8)
Fontoniko	0.0 (0.0)	0.5 (1.0)	0.6 (0.9)	0.0 (3.2)	0.0 (3.8)	0.3 (1.2)	0.0 (2.8)	0.0 (2.3)	4.2 (3.0)	1.2 (2.0)	0.0 (0.3)	0.0 (1.1)	0.0 (0.5)
Goat	2.5 (1.4)	0.0 (0.9)	0.0 (1.1)	9.6 (6.9)	0.3 (4.9)	3.4 (1.5)	0.0 (3.4)	3.3 (3.8)	1.8 (1.1)	0.1 (2.4)	0.0 (0.5)	0.3 (2.2)	1.1 (1.0)
Holmes	0.0 (0.5)	0.4 (1.2)	0.0 (1.0)	0.0 (6.2)	11.6 (7.1)	5.8 (3.5)	0.0 (0.8)	0.0 (2.4)	10.3 (4.6)	11.3 (7.2)	4.6 (2.9)	3.0 (5.1)	5.5 (3.5)
Horsey	0.0 (0.2)	0.0 (0.0)	0.0 (0.2)	1.4 (3.0)	0.0 (2.2)	1.0 (0.6)	0.0 (1.4)	0.0 (0.9)	0.0 (0.7)	1.8 (1.3)	0.0 (0.2)	0.9 (1.5)	0.0 (0.1)
Indianpoint	0.0 (1.6)	0.0 (0.9)	0.3 (2.2)	16.9 (9.0)	0.0 (2.1)	0.0 (0.8)	9.2 (5.9)	6.3 (5.3)	0.0 (0.6)	0.0 (1.2)	0.0 (1.0)	2.3 (2.9)	0.9 (1.2)
MacGregor	0.0 (0.4)	0.0 (0.0)	0.0 (0.0)	0.5 (7.2)	10.3 (8.7)	0.0 (0.7)	0.0 (2.5)	0.0 (2.8)	0.0 (1.4)	0.0 (0.9)	0.0 (0.6)	1.9 (2.2)	1.0 (2.1)
Nechako/Stuart	20.1 (6.5)	16.0 (5.8)	8.6 (4.4)	0.0 (5.6)	0.0 (6.7)	12.7 (4.1)	6.9 (6.4)	5.4 (7.9)	21.1 (7.6)	9.0 (4.8)	13.6 (5.0)	5.8 (6.7)	9.0 (4.4)
Salmon@PG	3.2 (2.9)	1.7 (3.4)	1.3 (3.1)	0.0 (4.6)	10.6 (10.4)	6.8 (2.9)	12.8 (7.9)	7.5 (9.3)	0.1 (4.4)	14.2 (7.5)	4.9 (3.5)	8.9 (4.9)	4.7 (3.4)
Slim	0.0 (1.1)	0.0 (0.0)	4.4 (2.1)	0.0 (6.6)	0.0 (1.1)	0.0 (0.7)	0.0 (3.1)	0.0 (0.0)	0.0 (0.3)	0.0 (0.3)	0.0 (0.7)	0.0 (0.4)	0.0 (0.4)
Swift	0.0 (0.3)	0.0 (0.0)	0.0 (0.1)	0.0 (0.5)	0.0 (0.0)	0.3 (1.0)	0.0 (0.8)	0.0 (1.4)	0.0 (0.0)	0.2 (1.6)	0.0 (0.1)	0.0 (1.2)	0.9 (1.0)
Tete Jeune	0.0 (0.0)	0.0 (0.2)	0.0 (0.0)	0.0 (2.0)	0.0 (2.4)	0.0 (1.0)	0.0 (1.3)	2.5 (3.3)	0.0 (2.1)	0.0 (1.3)	0.0 (0.3)	8.7 (4.1)	0.0 (0.9)
Willow	0.0 (1.0)	0.0 (1.1)	0.0 (2.1)	0.0 (5.7)	0.0 (4.6)	5.1 (2.2)	2.5 (4.7)	8.8 (5.5)	0.0 (2.1)	9.2 (4.4)	2.5 (2.3)	1.6 (2.3)	2.7 (1.9)
Up-Fraser	28.2 (7.5)	18.6 (6.3)	15.2 (5.7)	29.7 (13.8)	39.0 (14.5)	38.9 (4.6)	38.6 (12.0)	36.8 (12.0)	37.7 (7.4)	48.2 (8.8)	26.7 (6.4)	33.5 (7.2)	25.6 (7.3)
Mid-Fraser	45.4 (7.8)	52.3 (7.3)	56.4 (6.6)	52.9 (14.1)	43.1 (15.5)	40.3 (5.1)	43.8 (13.0)	37.9 (10.7)	27.5 (7.0)	28.2 (8.6)	38.3 (6.2)	48.4 (7.8)	39.2 (7.1)
Thompson	21.6 (4.7)	29.2 (5.2)	28.5 (4.5)	17.4 (8.8)	17.9 (9.9)	20.2 (3.0)	16.8 (6.5)	25.3 (9.5)	34.9 (7.0)	23.6 (4.5)	35.0 (4.5)	18.1 (4.6)	35.2 (4.8)
Low-Fraser	4.8 (3.0)	0.0 (0.6)	0.0 (1.3)	0.0 (4.1)	0.0 (0.0)	0.6 (0.8)	0.8 (4.7)	0.0 (1.2)	0.0 (0.3)	0.0 (0.0)	0.0 (0.4)	0.0 (0.7)	0.0 (0.2)
Birkenhead	7.2 (2.9)	8.4 (2.5)	12.1 (2.7)	4.0 (4.2)	8.6 (5.7)	1.6 (0.8)	5.3 (3.1)	4.4 (2.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.6 (1.1)	0.0 (0.0)
Cold/Spius/Nicola	11.1 (5.6)	24.6 (5.3)	26.0 (5.2)	9.4 (5.9)	13.5 (7.6)	13.8 (2.6)	7.3 (5.4)	16.0 (7.0)	15.6 (6.1)	15.0 (5.8)	28.4 (4.8)	13.5 (4.0)	25.1 (4.7)
Up./Lower Chilcot	32.3 (6.2)	30.3 (6.2)	34.8 (6.0)	18.5 (10.3)	26.2 (11.3)	13.4 (2.8)	13.9 (7.7)	9.7 (5.7)	18.1 (6.2)	10.7 (4.0)	23.3 (4.6)	19.6 (4.5)	18.6 (4.4)
Total Early	50.6	63.3	72.9	31.9	48.3	28.8	26.5	30.1	33.7	25.7	51.7	33.7	43.7

Appendix 7 cont'd.

	May 22-24		May 29-31		June 5-7		June 12-14		June 19-21		>June 27	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
N	234	99	201	37	245	85	258	172	322	203	63	113
Harrison	0.0 (0.3)	0.0 (0.4)	0.0 (0.6)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Birkenhead	0.0 (0.8)	1.0 (1.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.7)	0.0 (0.0)
W_Chilliwack	1.2 (1.1)	0.0 (0.0)	1.0 (1.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.8 (1.9)	0.0 (0.0)
Bonaparte	1.2 (1.7)	2.5 (2.2)	1.9 (2.5)	0.0 (2.0)	0.0 (0.6)	0.0 (0.5)	0.4 (1.1)	2.7 (2.1)	0.3 (0.8)	2.6 (1.6)	0.0 (0.0)	3.5 (2.3)
Cold/Spius/Nicola	9.7 (2.8)	30.7 (4.9)	9.8 (3.6)	27.6 (9.4)	4.2 (2.6)	13.2 (3.5)	8.2 (2.5)	12.4 (3.2)	3.0 (1.5)	8.2 (2.3)	6.0 (5.1)	6.6 (2.7)
Deadman	0.0 (0.6)	0.0 (2.9)	0.0 (0.7)	0.0 (2.3)	1.1 (1.2)	0.0 (1.0)	0.0 (0.7)	0.9 (1.7)	0.0 (0.8)	2.7 (1.8)	0.0 (0.0)	0.0 (0.6)
Blackwater	3.9 (1.5)	0.0 (1.2)	1.6 (1.4)	0.0 (1.4)	0.0 (0.4)	0.0 (0.5)	0.3 (1.2)	1.6 (1.1)	0.0 (0.2)	0.3 (0.6)	3.4 (2.8)	0.9 (1.0)
Bridge	0.3 (3.7)	0.6 (2.6)	4.0 (5.0)	4.1 (4.8)	3.0 (3.5)	10.2 (5.2)	16.3 (4.3)	2.6 (3.5)	8.5 (4.1)	4.2 (3.3)	0.0 (2.4)	0.0 (0.0)
Up./Lower Chilcot	12.2 (3.7)	13.3 (4.3)	4.8 (2.5)	4.7 (5.5)	3.2 (1.9)	2.5 (1.8)	0.8 (1.8)	8.4 (2.2)	3.2 (2.6)	10.4 (3.0)	6.5 (4.6)	12.1 (4.2)
Chilko	0.0 (1.4)	0.0 (0.0)	0.0 (1.0)	3.6 (2.9)	0.0 (0.4)	0.0 (0.4)	0.0 (1.1)	0.0 (1.0)	3.4 (2.0)	0.5 (0.8)	0.0 (0.8)	1.9 (1.3)
Cottonwood	7.0 (3.5)	8.0 (2.9)	6.6 (2.8)	5.0 (3.3)	5.5 (2.5)	6.8 (3.4)	2.7 (1.8)	2.5 (1.5)	0.0 (1.0)	6.0 (1.9)	0.0 (1.1)	3.9 (2.4)
Elkin	0.0 (0.1)	0.0 (0.0)	0.0 (0.5)	0.0 (0.0)	0.0 (0.2)	0.0 (0.4)	0.2 (1.2)	0.0 (1.0)	0.0 (0.4)	0.0 (0.0)	0.0 (0.4)	1.6 (1.3)
Endako	8.1 (3.6)	2.3 (2.0)	7.5 (3.0)	0.0 (0.0)	4.9 (2.6)	0.0 (0.8)	2.1 (1.6)	3.1 (1.7)	0.6 (1.6)	0.0 (0.9)	6.6 (4.6)	2.0 (1.6)
Horsefly	0.2 (2.2)	1.0 (0.6)	0.0 (1.7)	0.0 (0.0)	0.0 (1.5)	0.5 (1.6)	0.0 (1.3)	2.1 (1.4)	0.0 (1.0)	1.0 (0.8)	0.0 (2.7)	0.0 (0.3)
Portage	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (2.0)	0.2 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Quesnel	0.0 (1.4)	1.8 (2.9)	0.0 (1.4)	7.6 (5.3)	0.0 (2.6)	2.1 (4.1)	0.0 (1.6)	2.8 (3.2)	0.0 (0.9)	0.7 (1.9)	0.2 (6.3)	2.6 (5.1)
Taseko	0.2 (1.2)	0.0 (0.1)	0.0 (0.4)	0.0 (1.0)	1.2 (1.5)	0.0 (0.0)	1.0 (1.1)	0.0 (0.7)	0.9 (1.5)	0.0 (0.2)	0.0 (1.8)	0.0 (0.1)
Clearwa(Thom)	2.6 (1.9)	0.0 (0.1)	2.2 (1.5)	0.0 (0.0)	0.6 (1.2)	0.0 (0.5)	0.0 (0.8)	0.4 (0.5)	1.4 (1.3)	1.4 (0.9)	0.0 (3.8)	0.0 (0.2)
Finn	0.0 (0.6)	0.0 (0.6)	0.7 (1.1)	0.0 (1.1)	1.0 (0.9)	0.0 (0.1)	1.4 (0.9)	0.0 (0.0)	1.3 (1.1)	1.0 (0.9)	2.9 (2.8)	0.0 (0.0)
Louis	0.4 (1.0)	0.9 (0.8)	0.0 (0.8)	0.0 (0.0)	1.8 (1.4)	0.0 (0.0)	0.0 (0.4)	0.6 (0.6)	0.0 (0.2)	0.6 (0.7)	0.0 (0.7)	0.0 (0.1)
Mahood	0.0 (0.5)	0.0 (0.4)	0.3 (0.4)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.7 (0.7)	0.0 (0.0)	0.9 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.2)
Raft	0.0 (0.9)	0.0 (1.7)	2.3 (2.1)	0.0 (2.6)	0.1 (1.1)	2.3 (2.7)	0.1 (0.8)	0.0 (1.6)	1.6 (1.6)	0.5 (0.9)	0.0 (2.2)	2.3 (1.6)
Eagle	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (1.1)	0.0 (0.3)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.0 (0.6)	0.0 (0.0)
L Shuswap	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.7)	0.6 (0.5)	0.0 (0.1)	0.0 (0.7)	0.4 (1.0)	0.0 (1.3)	0.0 (0.1)	2.8 (2.2)	0.0 (0.5)
Little R	0.0 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.4)	0.0 (0.0)	0.0 (0.3)	0.5 (0.7)
Lower Adams	0.0 (0.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.2)	0.0 (0.1)	0.0 (0.2)	0.0 (0.6)	1.7 (1.2)
M Shuswap	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.2)	0.0 (0.6)	1.2 (1.1)	0.4 (0.7)	5.7 (2.1)	0.0 (0.3)	0.0 (0.0)	0.0 (0.3)
Salmon@SA	0.0 (0.3)	0.0 (1.0)	1.8 (1.2)	0.0 (0.3)	1.3 (1.0)	0.0 (0.2)	1.2 (1.2)	0.0 (0.4)	0.0 (0.8)	0.6 (0.7)	0.0 (0.8)	0.0 (0.7)
South Thom	0.0 (0.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.3 (0.9)	0.0 (0.2)	0.0 (0.9)	1.1 (1.2)
Bowron	5.9 (3.9)	3.0 (3.1)	0.0 (2.7)	10.0 (9.2)	1.1 (3.3)	0.0 (2.6)	1.8 (4.2)	0.9 (2.6)	1.1 (3.1)	0.5 (1.8)	9.1 (6.5)	6.5 (4.1)
Dome	5.9 (4.5)	0.0 (2.4)	8.6 (5.6)	0.0 (2.4)	7.2 (4.4)	9.1 (4.7)	0.0 (3.2)	10.1 (4.0)	10.1 (3.7)	10.4 (3.9)	11.0 (7.0)	6.7 (4.1)
Fontoniko	0.5 (1.7)	0.0 (1.5)	2.9 (2.1)	0.0 (2.0)	0.4 (2.5)	4.7 (2.5)	0.1 (1.9)	0.0 (1.2)	2.5 (2.0)	0.0 (0.4)	0.0 (4.6)	2.1 (1.5)
Goat	1.3 (2.1)	0.0 (0.7)	7.8 (3.0)	0.0 (0.6)	11.9 (3.8)	0.0 (0.7)	13.7 (3.3)	0.7 (0.5)	6.2 (2.6)	0.0 (1.0)	16.5 (6.6)	1.9 (0.8)
Holmes	14.0 (5.4)	9.9 (4.9)	8.3 (6.1)	9.5 (5.8)	10.5 (6.1)	19.9 (6.4)	16.2 (5.6)	12.5 (4.3)	18.0 (5.0)	17.8 (4.4)	16.6 (10.0)	8.7 (3.6)
Horsey	0.0 (0.7)	0.0 (0.2)	1.2 (1.6)	0.5 (1.9)	1.1 (1.3)	0.0 (0.7)	3.4 (1.8)	0.0 (0.3)	3.0 (1.6)	0.0 (0.2)	3.6 (4.2)	0.0 (0.4)
Indianpoint	0.0 (1.1)	3.0 (2.0)	0.0 (1.5)	0.0 (2.9)	0.1 (1.3)	0.9 (1.4)	0.0 (1.6)	0.0 (0.7)	0.0 (1.4)	0.0 (0.6)	0.0 (2.4)	2.9 (2.1)
MacGregor	1.7 (1.8)	0.0 (2.4)	2.9 (3.5)	0.0 (3.6)	13.5 (4.4)	0.0 (2.0)	15.1 (6.2)	8.8 (3.4)	8.1 (3.8)	6.3 (3.5)	0.0 (3.9)	5.3 (4.3)
Nechako/Stuart	9.7 (4.7)	15.4 (5.5)	3.6 (3.7)	2.8 (5.6)	4.8 (3.3)	9.3 (5.6)	0.0 (0.0)	14.2 (3.9)	0.0 (2.6)	4.6 (3.4)	6.0 (5.1)	7.2 (4.9)
Salmon@PG	11.1 (4.7)	1.7 (3.0)	5.2 (4.0)	17.7 (11.6)	12.2 (4.8)	3.8 (3.7)	4.2 (3.3)	2.8 (2.8)	4.7 (3.1)	12.9 (4.0)	0.0 (3.9)	15.0 (4.9)
Slim	0.0 (0.6)	0.0 (1.1)	0.0 (1.2)	6.6 (4.5)	0.0 (0.7)	0.0 (1.1)	0.0 (1.8)	1.3 (1.9)	1.7 (2.4)	0.7 (1.2)	0.0 (1.0)	0.0 (1.0)
Swift	0.1 (1.5)	0.4 (1.3)	0.0 (0.3)	0.0 (3.0)	0.0 (1.3)	3.1 (3.4)	2.1 (2.2)	1.0 (1.1)	0.6 (1.8)	1.8 (1.3)	2.8 (3.7)	0.4 (1.3)
Tete Jeune	1.7 (1.8)	0.0 (2.7)	6.9 (4.2)	0.0 (1.0)	1.7 (2.7)	10.2 (4.2)	3.4 (4.1)	0.0 (0.9)	12.0 (3.8)	3.4 (2.5)	6.6 (8.9)	1.7 (2.3)
Willow	1.2 (2.3)	4.6 (2.7)	8.1 (4.1)	0.3 (5.3)	7.0 (3.5)	1.6 (2.3)	3.4 (2.9)	6.9 (3.0)	0.1 (2.1)	0.9 (1.6)	0.0 (2.5)	1.1 (1.9)
Up-Fraser	53.0 (7.0)	38.0 (6.2)	55.5 (5.5)	47.4 (12.8)	71.3 (5.1)	62.4 (8.5)	63.4 (4.9)	59.1 (5.9)	68.0 (5.1)	59.2 (4.5)	72.2 (10.6)	59.5 (5.7)
Mid-Fraser	31.9 (6.9)	28.0 (6.4)	24.6 (5.4)	24.9 (10.3)	18.0 (5.4)	22.1 (7.5)	23.4 (4.5)	23.2 (5.2)	16.6 (4.6)	23.2 (4.5)	16.6 (9.0)	24.9 (5.9)
Thompson	13.9 (3.2)	34.1 (6.1)	19.0 (3.0)	27.6 (9.2)	10.6 (3.1)	10.6 (4.5)	13.2 (2.9)	17.7 (3.8)	15.5 (3.1)	17.6 (2.9)	10.4 (5.8)	15.6 (3.5)
Low-Fraser	1.2 (1.1)	0.0 (0.7)	1.0 (1.0)	0.0 (0.0)	0.0 (0.3)	0.0 (1.0)	0.0 (0.1)	0.0 (0.3)	0.0 (0.0)	0.0 (0.0)	0.8 (1.9)	0.0 (0.5)
Birkenhead	0.0 (0.8)	1.0 (1.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.7)	0.0 (0.0)
Cold/Spius/Nicola	9.7 (2.8)	30.7 (4.9)	9.8 (3.6)	27.6 (9.4)	4.2 (2.6)	13.2 (3.5)	8.2 (2.5)	12.4 (3.2)	3.0 (1.5)	8.2 (2.3)	6.0 (5.1)	6.6 (2.7)
Up./Lower Chilcot	12.2 (3.7)	13.3 (4.3)	4.8 (2.5)	4.7 (5.5)	3.2 (1.9)	2.5 (1.8)	0.8 (1.8)	8.4 (2.2)	3.2 (2.6)	10.4 (3.0)	6.5 (4.6)	12.1 (4.2)
Total Early	21.9	45	14.6	32.3	7.4	15.7	9	20.8	6.2	18.6	12.5	18.7